UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

EPA Region 5 Records Ctr.
203677

OCT 0 3 2002

REPLY TO THE ATTENTION OF

SR-6J

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

RESPONDENTS:

See Attached Distribution List

Re: Sauget Area 2 Site - Groundwater Operable Unit
Sauget, Illinois
Notice under Section 122(a) of CERCLA and
Unilateral Administrative Order

To the Addressees on the attached Distribution List:

This letter notifies you that the United States Environmental Protection Agency ("U.S. EPA") has determined not to use special notice procedures pursuant to Section 122(e) of the Comprehensive Environmental Response, Compensation, and Liability Act, as amended ("CERCLA"), at the above referenced site regarding the Remedial Design/Remedial Action ("RD/RA") for the Sauget Area 2 Site Groundwater Operable Unit ("OU"). The OU is part of a larger Superfund Site known as Sauget Area 2 (the "Site").

As indicated in the Special Notice letter regarding conditions at the Area 2 Site sent on June 23, 2000, to Area 2 potentially responsible party ("PRPs"), U.S. EPA has evaluated volumes of existing information in connection with its investigation of the Site. Additional information about the Site has been gathered during the course of the ongoing Sauget Area 2 and recently completed Sauget Area 1 Remedial Investigation ("RI") process and through other efforts. As a result of this information, you or your company have been identified as one of the parties that is potentially responsible for contributing hazardous substances to the Sauget Area 2 Site Groundwater OU. U.S. EPA has information indicating that you may be a PRP as defined at Section 107(a) of the CERCLA, 42 U.S.C. § 9607(a), with respect to hazardous substances associated with this OU. The OU only encompasses the groundwater contamination releasing to the Mississippi River adjacent to Site R and the resulting impact area in the Mississippi River. The U.S. EPA expects to act quickly to initiate remedial activities at this OU.

On September 30, 2002, the U.S. EPA selected an interim remedy for the OU pursuant to its authority under CERCLA. The State of Illinois has indicated its intention to concur with the selected remedy. The selected remedy includes the installation of a 3,500 foot long, "U"-shaped, fully penetrating, jet grout barrier wall to be installed between the downgradient boundary of Sauget Area 2 Site R and the Mississippi River to abate the release of impacted groundwater. Three partially penetrating groundwater recovery wells will be installed inside the "U"-shaped barrier wall to control groundwater moving to the wall. Groundwater quality, groundwater level, sediment and surface water monitoring will be used to ensure acceptable performance of the interim groundwater remedy. Extracted groundwater will be treated and ultimately discharged to the Mississippi River in compliance with all applicable or relevant and appropriate requirements.

Section 122(a) of CERCLA requires that U.S. EPA notify PRPs whenever it determines not to use the settlement procedures set forth in Section 122 of CERCLA. The U.S. EPA has decided not to invoke the settlement procedures under Section 122 of CERCLA because it believes they will not expedite remedial action at the OU. In this case, U.S. EPA believes that remedial action can begin this year only if U.S. EPA issues a Unilateral Administrative Order ("UAO") for the RD/RA in short order. Solutia, Inc., which is one of the generators who sent waste to the Site, has indicated that in light of ongoing discussions and the proposed remedial schedule, the statutory settlement procedures are not necessary to expedite clean-up.

Therefore, enclosed please find a UAO issued by the U.S. EPA under Section 106 of the CERCLA, 42 U.S.C. Section 9601, et seq. Please note that the Order allows an opportunity for a conference if requested within ten (10) days after the date of issuance of this Order and an opportunity to submit comments on or before the effective date of this Order which is thirty (30) days after the date of issuance.

The decision not to use the special notice procedures does not preclude you from entering into discussions with U.S. EPA regarding your participation in response activities for the OU. This decision simply means that U.S. EPA will not use the special notice procedures to govern any future discussions. U.S. EPA encourages any offers regarding settlement of this matter and participation in response activities. As indicated above, Solutia is already cooperating with U.S. EPA in expediting cleanup at the OU. If you are interested in joining these efforts, you may want to contact Linda Tape, Esq., who is representing Solutia in these matters, at (314)480-1839.

If you have any questions concerning the remedial actions described herein, please contact Mike Ribordy, Remedial Project Manager, at (312) 886-4592. If you have any legal questions, please contact Thomas Martin, of the Office of Regional Counsel, at (312) 886-4273.

Sincerely,

Wm. E. Muno

William E. Muno, Director
Superfund Division
U.S. Environmental Protection Agency, Region 5

Enclosures

cc: Renee Cipriano, Director
Illinois EPA

ATTACHMENT 1

Note inclusion on or exclusion from the list does not constitute a final determination by the Agency concerning the liability of any party for remediation of OU site conditions or payment of past costs

A-1 Oil Corporation
Aalco Wrecking & Supply Co
Abco Trash Service & Equipment Company
Alton & Southern Railroad
Phelps Dodge Corporation (formerly known as or successor to Cyprus Amax Minerals Co , Amax Zinc)
American Zinc Company (also known as or predecessor to American Zinc, Lead and Smelting Co., Gold Fields America Corp, Blue Tee Corp)
Barry Weinmiller Steel Fabrication
Bi-State Transit Co.
Bi-State Parks Airport
Bi-State Development Agency
Bliss Waste Oil Inc.
Blue Tee Corp.
Browning Ferris Industries of North America – successor to·
C&E Hauling
Cahokia Trust Properties
Cargill Inc.
Century Electric
Century Foundry
Cerro Copper Products Company
Chemical Waste Management Inc
Clayton Chemical Limited Liability Corp
Con-Agra, Inc.
Corkery Fuel Company
Crown Cork & Seal Co. Inc
David Hauling
Dennis Chemical Co Inc
Disposal Services Co
Dotson Disposal "All" Service
Dow Chemical
Eagle Marine Industries, Inc (formerly known as Notre Dame Fleeting and Towing Inc , and which merged with Riverport Terminal and Fleeting Inc)
Edgemont Construction
Edwin Cooper Inc
Eight & Trendy Metal Company
Evans Brothers
Emerald Environmental Group LLC (formerly known as Clayton Chemical)
Ethyl Corporation (formerly known as Edwin Cooper Corporation)
Ethyl Petroleum Additives, Inc

2

ExxonMobil Corp (formerly known as Mobil)
Fruin-Colnon Corporation
The Glidden Co (formerly known as U S Paint)
Gold Fields American Corporation
Hilltop Hauling
Huffmeier Brothers
Illinois Department of Transportation
Industrial Salvage & Disposal Company
Inmont Corporation
Kerr McGee (formerly known as T J Moss and Moss American)
Lead and Smelting Company
Mallinckrodt Chemical
Manor Chemical
Midwest Rubber Reclaiming, Division of Empire Chem Inc
Mobil Oil Corporation
Monsanto Chemical Company
Olin Corporation
Onyx Environmental Services
Pharmacia Corporation (formerly known as Monsanto Co)
National Vendors
Northfolk Southern Corporation
Notre Dame Fleeting and Towing Services
Patgood, Inc
Peavey Company
Phillips Pipe Line Company
Pillsbury Company
River Port Terminal and Fleeting Company
Rogers Cartage
Russell Bliss
Sauget & Co
Sauget Sanitary Development and Research Assn
Paul Sauget
Solutia Inc
St Louis Grain Co
Union Electric d/b/a Ameren UE
U S Paint Corporation
Village of Cahokia
Village of Sauget
Wiese Planning and Engineering

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

IN THE MATTER OF	)	
	)	
Sauget Area 2 Superfund Site	)	
Sauget, Cahokia, and East	)	
St Louis, Illinois	)	
	)	Docket No V-W-'02-C-716
RESPONDENTS	)	
	)	
See Attachment 1	)	
	)	
Proceeding Under Section 106(a) of the	)	
Comprehensive Environmental Response,	)	
Compensation, and Liability Act of 1980,	)	
as amended (42 U S C § 9606(a))	)	

ADMINISTRATIVE ORDER FOR REMEDIAL DESIGN AND INTERIM REMEDIAL ACTION

I INTRODUCTION AND JURISDICTION

1 This Order directs Respondents to perform a remedial design for the Interim Groundwater Remedy described in the Record of Decision, dated September 30, 2002, and to implement the design by performing an interim remedial action This Order is issued to Respondents by the United States Environmental Protection Agency ("U S EPA") under the authority vested in the President of the United States by Section 106(a) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended ("CERCLA"), 42 U S C § 9606(a) This authority was delegated to the Administrator of U S EPA on January 23, 1987, by Executive Order 12580 (52 Fed Reg 2926), and was further delegated to the Regional Administrator on September 13, 1987 by U S EPA Delegation No 14-14 and 14-14A, and to the Director, Superfund Division, Region 5 by delegation 14-14B

II PARTIES BOUND

2 This Order shall apply to and be binding upon each Respondent identified in paragraphs 19 and 20 and its successors and assigns Each Respondent is jointly and severally responsible for carrying out all activities required by this Order Failure of one or more Respondents to comply with all or any part of this Order shall not in any way excuse or justify noncompliance by any other Respondents No change in the ownership, corporate status, or other control of any Respondent shall alter any of the Respondent's responsibilities under this Order

3 Each Respondent shall provide a copy of this Order to any prospective owners or successors before a controlling interest in Respondent's assets property rights or stock are

transferred to the prospective owner or successor Respondents shall provide a copy of this Order to each contractor subcontractor laboratory or consultant retained to perform any work under this Order, within five days after the effective date of this Order or on the date such services are retained, whichever is later Respondents shall also provide a copy of this Order to any person acting on behalf of Respondents with respect to the Site or the work and shall ensure that all contracts and subcontracts entered into hereunder require performance under the contract to be in conformity with the terms and work required by this Order With regard to the activities undertaken pursuant to this Order, each contractor and subcontractor shall be deemed to be related by contract to the Respondents within the meaning of Section 107(b)(3) of CERCLA, 42 U S C § 9607(b)(3) Notwithstanding the terms of any contract, each Respondent is responsible for compliance with this Order and for ensuring that its contractors, subcontractors and agents perform all work in accordance with this Order

4 Not later than thirty (30) days prior to any transfer of any interest in any real property included within the Site, Respondent(s) shall submit a true and correct copy of the transfer documents to U S EPA, and shall identify the transferee(s) by name, principal business address and effective date of the transfer

III DEFINITIONS

5 Unless otherwise expressly provided herein, terms used in this Order which are defined in CERCLA or in regulations promulgated under CERCLA shall have the meaning assigned to them in the statute or its implementing regulations Whenever terms listed below are used in this Order or in the documents attached to this Order or incorporated by reference into this Order, the following definitions shall apply

a "CERCLA" shall mean the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, 42 U S C §§ 9601 et seq

b "Day" shall mean a calendar day unless expressly stated to be a working day In computing any period of time under this Order, where the last day would fall on a Saturday, Sunday, or federal holiday, the period shall run until the end of the next working day

c "Illinois EPA" shall mean the Illinois Environmental Protection Agency

d "National Contingency Plan" or "NCP" shall mean the National Contingency Plan promulgated pursuant to Section 105 of CERCLA, 42 U S C § 9605, codified at 40 C F R Part 300, and any amendments thereto

e "Operable Unit" or OU" pertains to the groundwater contamination releasing to the Mississippi River adjacent to Sauget Area 2 disposal Site R and the resulting impact area

f "Paragraph" shall mean a portion of this Order identified by an Arabic numeral

g "Performance Standards" shall mean those cleanup standards, standards of control, and other substantive requirements, criteria or limitations, identified in the Record of Decision and Statement of Work, that the remedial action and work required by this Order must attain and maintain

h 'Record of Decision" or "ROD" shall mean the U S EPA Record of Decision relating to the OU, signed on September 30, 2002 by the Director of the Superfund Division, U S EPA, Region 5, and all attachments thereto, which is attached hereto and made a part hereof as Attachment 2

i. "Response Costs" shall mean all costs, including direct costs, indirect costs, and interest incurred by the United States to perform or support response actions at the Site relating to the OU, including, but not limited to, contract and enforcement costs.

j. "Section" shall mean a portion of this Order identified by a Roman numeral and includes one or more paragraphs.

k. "Section 106 Administrative Record" shall mean the Administrative Record which includes all documents considered or relied upon by U.S. EPA in preparation of this Order. The Section 106 Administrative Record Index is a listing of all documents included in the Section 106 Administrative Record, and is attached hereto as Attachment 3.

l. "Site" pertains to the Sauget Area 2 Superfund Site.

m. "State" shall mean the State of Illinois.

n. "Statement of Work" or "SOW" shall mean the statement of work for implementation of the remedial design, remedial action, and operation and maintenance at the OU, as set forth in Attachment 4 to this Order. The Statement of Work is incorporated into this Order and is an enforceable part of this Order.

o. "Work" shall mean all activities Respondents are required to perform under this Order and all attachments hereto, including, but not limited to, remedial design, remedial action and operation and maintenance.

IV. DETERMINATIONS

Based on available information, including the Administrative Record in this matter, U.S. EPA hereby finds that:

6. The OU encompasses the groundwater contamination releasing to the Mississippi River adjacent to Site R and the resulting impact area in the Mississippi River. This area is part of a larger Superfund Site known as Sauget Area Two ("the Site"). Based on current information, the impact area resulting from the above-described groundwater release is confined to an area approximately 2000 feet long (coinciding with the northern and southern boundaries of Site R) and approximately 300 feet from shore (see map attached as Exhibit 1).

7. From October 24, 2000, through November 3, 2000, U.S. EPA collected sediment samples in the Mississippi River in and adjacent to the impact area from the above-described groundwater releases. Sediment samples were analyzed for VOCs, SVOCs, PCBs and pesticides, but not heavy metals. U.S. EPA data shows that sediment is contaminated with significant concentrations of volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) starting at the northern edge of Site R. Based on this data, the northern area of Site R is also the approximate northern boundary of a groundwater contaminant plume that releases to the Mississippi River in the vicinity of Site R. These data show that significant concentrations of VOCs and SVOCs in sediment continue along and south of Site R, the approximate southern boundary of the groundwater contaminant plume. Significant concentrations of pesticides, a herbicide, and polychlorinated biphenyls (PCBs) are also shown in these data near the middle and southern boundary of Site R, in the approximate center of the groundwater contaminant plume. The areal extent of contaminated sediment in the Mississippi River is best defined by the presence of chlorobenzene at twelve sample locations, 4-chloroaniline at seven sample locations,

and benzene at six sample locations. Aniline was also found in sediment at five locations, dichlorobenzenes and Aroclor (PCBs) at four locations, and Δ-BHC at three locations. Other hazardous constituents found in one or two sediment sample locations are toluene, 1,2-dichloroethane, xylenes, ethylbenzene, 2-chlorophenol, bis(2-ethylhexyl) phthalate, 2,4-dichlorophenol, 3-methylphenol, phenol, chlorobenzilate, 4.4'-DDD, methoxychlor, and 2,4-D. The greatest concentration of contaminants found in sediment occurs near and just south of the middle portion of Site R.

8. Groundwater data collected by Solutia and presented in the Description of Current Conditions Report for the W.G. Krummrich Facility and the Sauget Area 2 Focused Feasibility Study correlates well with both the type and extent of contamination found in Mississippi River sediment. Groundwater data from May 2000 for wells monitoring the middle and deep sand aquifer near the northern extent of sediment contamination (wells GM-27B and GM-27C) found up to 1,400 parts per billion (ppb) of benzene, 11,000 ppb of chlorobenzene, 700 ppb of toluene, 39,000 ppb of aniline, 8,100 ppb of phenol, 300 ppb of 4-chlorophenol, 20,000 ppb of 2-chloroaniline, 25,000 ppb of 3-chloroaniline, and 25,000 ppb of 4-chloroaniline.

9. Historical groundwater data collected by Monsanto and presented in the Remedial Investigation at Sauget Site R (Geraghty & Miller, 1994) also shows a strong correlation between groundwater contaminants and sediment data at the locations referenced above. Solutia Wells GM-27B and GM-27C show similar groundwater contamination as determined in May 2000. Groundwater data collected between 1986 and 1992, found benzene concentration in groundwater ranged from 122 to 9,980 ppb, chlorobenzene concentrations ranged from 193 to 60,200 ppb, toluene concentrations ranged from <6 to 1,400 ppb, aniline concentrations ranged from 869 to 440,000 ppb, phenol concentrations ranged from <1.5 to 1,910 ppb, 2-chloroaniline concentrations ranged from 3,220 to 59,100 ppb, 3-chloroaniline concentrations ranged from <10 to 52,400 ppb, and 4-chloroaniline concentrations ranged from <10 to 53,100 ppb. None of the historical samples were analyzed for heavy metals.

10. Data from wells GM-57C and GM-56C, located near the center of Site R, shows similar contaminants as found in Mississippi River sediment. Groundwater data collected between 1987 and 1992, found benzene concentrations ranged from <44 to 613 ppb, chlorobenzene concentrations ranged from <440 to 7380 ppb, toluene concentrations ranged from <160 to 2,070 ppb, aniline concentrations ranged from 20,600 to 44,800 ppb, phenol concentrations ranged from <1.7 to 33,000 ppb , 2-chloroaniline concentrations ranged from <500 to 195,000 ppb, 3-chloroaniline concentrations ranged from <25,200 to 41,800 ppb, 4-chloroaniline concentrations ranged from 26,200 to 56,900 ppb, and 1,2-dichlorobenzene concentrations ranged from 204 to 1570 ppb.

11. Wells GM-28B, GM-28C, and GM-55C, located near the southern boundary of Site R also detected the same contaminants as found in Mississippi River sediment. Data collected between 1986 and 1992, found benzene concentrations ranged from 85.5 to 582 ppb, chlorobenzene concentrations ranged from 447 to 47,000 ppb, toluene concentrations ranged from <6 to 533 ppb, aniline concentrations ranged from <1,000 to 24,300 ppb, phenol concentrations ranged from <1.7 to 29,500 ppb, 2-chloroaniline concentrations ranged from 12,000 to 58,100

ppb, 3-chloroaniline concentrations ranged from 9,170 to 52,400 ppb, 4-chloroaniline concentrations ranged from 5,390 to 53,100 ppb, and 1,2-dichlorobenzene concentrations ranged from 6 to 9,810 ppb.

12. Solutia plotted and contoured the Total VOC and Total SVOC concentrations from their January and May 2000 groundwater sampling events for the Shallow Hydrogeologic Unit (SHU), Middle Hydrogeologic Unit (MHU) and Deep Hydrogeologic Unit (DHU). The results were presented in the Sauget Area 2 Focused Feasibility Study (FFS) conducted by Solutia. Based on these isoconcentration plots, VOCs and SVOCs are present in groundwater from the Mississippi River to the W.G. Krummrich Plant. Three groundwater concentration highs are present in groundwater beneath and upgradient of Sauget Area 2 Site R: 1) one at Sauget Area 2 Sites R and Q (dog leg) immediately adjacent to the Mississippi River, 2) another at the W.G. Krummrich plant owned and operated by Solutia, and to a lesser extent, 3) a third at the location of Sauget Area 2 Site O.

13. As part of its 1998 report, E&E prepared isoconcentration maps showing Total VOC concentration in shallow wells, Total VOC concentration in intermediate/deep wells, Total base neutrals/acids (BNA) concentration in shallow wells and Total BNA concentration in intermediate/deep wells. These isoconcentration maps show groundwater concentration highs in shallow wells at Sites O and R.

14. The source areas of the groundwater contamination at the OU is suspected to be various disposal areas and facilities in the Sauget area. Sauget Areas 1 and 2 and surrounding areas have historically been used for waste disposal. Four disposal areas at Sauget Area 2 (Sites O, Q, R and S), one disposal area from Sauget Area 1 (Site I), the W.G. Krummrich Plant, Clayton Chemical and various other industrial facilities are located in the Sauget area upgradient of the OU and could be contributing to the groundwater contamination.

15. Information on the types of wastes disposed and the types and levels of contamination found at the above-referenced locations, have been provided to U.S. EPA from various sources including, but not exclusively from: 1) CERCLA 103(c) Submittals; 2) CERCLA 104(e) Responses; 3) Expanded Site Investigation Dead Creek Project Sites (E & E, 1988); 4) Description of Current Situation at the Dead Creek Project Sites (E & E, 1986); 5) May 1999 Expanded Site Inspection (Illinois EPA, 1999); 6) Sauget Area 1 EE/CA and RI/FS Support Sampling Plan Data Report (Solutia, 2001); 7) Sauget Area 1 and 2 Sites, St. Clair County, Illinois (E & E, 1998); 8) CERCLA Screening Site Inspection (SSI): Sauget Sites Area #2 (Illinois EPA Pre-Remedial Unit, 1991); 9) Human Health Risk Assessment for Site R (Dynamac and Geraghty & Miller, 1994); 10) Ecological Risk Assessment for Site R (Environmental Science and Engineering, 1995); 11) Baseline Ecological Risk Assessment (Menzie-Cura, 2001); 12) other Area 1 reports; 13) RCRA Facility Assessment Report for Clayton Chemical (Illinois EPA, 1990); 14) Final Draft Removal Assessment Report for Clayton Chemical Site (U.S. EPA START, 2001); 15) Description of Current Conditions Report for W.G. Krummrich Facility (Solutia, 2000); 16) Sauget Area 2 Site Focused Feasibility Study (Solutia, 2002); 17) Data Validation Report for Samples Collected October 24-November 3, 2000 (U.S. EPA, 2001); 18) Sauget Area 1 and 2 Sites-Volume 1 Area 1 Data Tables/Maps (E&E, 1998); 19) Sauget Area

1 and 2 Sites-Volume 2 Area 2 Data Tables/Maps (E&E, 1998), 20) Draft Engineering Evaluation/Cost Analysis for Sauget Area 1 (U S EPA/Solutia, 2002)

16 The Sauget Area 2 disposal sites are located in the City of East St Louis and the Villages of Sauget and Cahokia, Illinois The Sauget Area 2 sites consist of five inactive disposal sites that are located in an area historically used for heavy industry, including chemical manufacturing, metal refining, petroleum refining, power generation, and waste disposal Four of the five Area 2 sites (sites O, Q (dog leg), R and S) are located upgradient of the OU and the observed releases of groundwater to the Mississippi River

a Site O consists of four closed sludge dewatering lagoons associated with the Village of Monsanto/Sauget Wastewater Treatment Plant Site O is located on Mobil Avenue in Sauget, east of the flood control levee, and is located to the northeast of the American Bottoms Regional Wastewater Treatment Facility Between 1966-7 and approximately 1978, these lagoons were used to dispose of sludge from the Village of Monsanto/Sauget WWTP The lagoons were closed in 1980 by stabilizing the sludge with lime and covering it with approximately two feet of clean, low-permeability soil Currently the former lagoons are vegetated

b. Site Q is an inactive landfill in Sauget, Illinois and is bisected by the Alton and Southern Railroad into a northern portion and a southern portion The northern portion of Site Q consists of approximately 65 acres and is bordered on the north by Site R and Monsanto Avenue The northern portion is bordered on the south by the main track of the Alton and Southern Railroad and property owned by Patgood, Inc , on the east by the U S Army Corps of Engineers (USACE) flood control levee and Illinois Central Gulf Railroad, and on the west by the Mississippi River Disposal operations began at Site Q in the 1950s and continued until the 1970s Sauget & Company operated at Site Q from at least 1966 to 1973 The wastes disposed at Site Q included municipal waste septic tank pumpings, drums, organic and inorganic wastes, solvents, pesticides, paint sludges and demolition debris

c Site R is a closed industrial-waste disposal area located on the west side of the flood control levee adjacent to the Mississippi River Site R is north and west of Site Q Industrial Salvage and Disposal, Inc /Sauget & Company operated Site R for Monsanto from 1957-77 Process wastes from Monsanto's W G Krummrich and J F Queeny Plants were disposed at Site R In 1979, Monsanto completed the installation of a clay cover on Site R to cover waste, limit infiltration through the landfill, and reduce direct contact with fill material The cover's thickness ranges from 2 to 8 feet In 1985, Monsanto installed a 2,250 foot long rock revetment along the east bank of the Mississippi River adjacent to Site R The purpose of the stabilization project was to prevent further erosion of the riverbank and thereby minimize potential for the surficial release of waste material from the landfill As constructed, the revetment does not provide for the permanent containment of the chemical wastes and other contaminants in the landfill On February 13, 1992, the State of Illinois and Monsanto signed a consent decree entered in St Clair County Circuit Court requiring Monsanto to conduct a remedial investigation and feasibility study for Site R The results of the RI/FS were submitted to the State of Illinois in 1994 A final remedy for Site R has not been determined In 2000 and 2001 groundwater sampling by Solutia found contamination at Site R d Site S, located southwest of Site O, is a small disposal site The property is situated on the east side of the flood control levee In the mid-1960s, solvent recovery operations began at the Clayton Chemical facility The waste solvents were steam-stripped, resulting in still bottoms that were allegedly disposed in a shallow, on-site excavation that is now designated as Site S

17 In addition to the Sauget Area 2 disposal sites, there are other sites or facilities in the Sauget area located upgradient of the OU and which could contribute to the release of impacted groundwater to the Mississippi River This includes, but is not limited to, Sauget Area 1 Site I, the Clayton Chemical facility, and the W G Krummrich Plant

a. Site I is an inactive landfill that occupies approximately 19 acres of land and is located north of Queeny Avenue, west of Falling Springs Road, and south of the Alton & Southern Railroad in the Village of Sauget, Illinois Former Creek Segment A of Dead Creek borders Site I on the site's western side Site I was originally used as a sand and gravel pit Industrial, chemical and municipal wastes were disposed at Site I from approximately 1931 to 1957. Site I also served as a disposal area for contaminated sediments from historic dredgings of Dead Creek Segment A Site H is connected to Site I under Queeny Avenue and together they were known to be part of the "Sauget-Monsanto Landfill," which operated from approximately 1931 to 1957 The estimated volume of waste and contaminated fill material in Site I is 680,827 cubic yards

b. The Clayton Chemical facility is located at 1 Mobile Avenue, Sauget, Illinois, between Site O and the dog leg portion of Site Q, and was operated as a railroad repair yard from the 1930s to 1962, a crude oil topping plant from 1962 to the mid-1960s, and an oil and solvent reclamation facility from the mid-1960s until 1998 Hundreds of parties sent wastes to the facility Clayton Chemical blended hazardous waste fuel for use by industrial furnaces Its facility included on-site bulk and drum storage, waste materials processing for fuels, a liquid fuel blending storage tank system and solvent recovery units Wastes were received by Clayton Chemical by either bulk or in containers Clayton Chemical Company was renamed Resource Recovery Group LLC in 1996 The Clayton Chemical facility ceased operating in 1998, and was the subject of an emergency response action by U S EPA in 2001 Wastes disposed at the Clayton facility included oil tank bottoms white gas, and spent halogenated and non-halogenated solvents

c The W G Krummrich plant, a currently operating chemical production facility, began operations in Sauget in the early 1900's Chemicals manufactured at the plant include sulfuric, muriatic and nitric acids, zinc chloride, phenol, chlorine, caustic soda, chlorobenzenes, para-nitroaniline, catalysts for contact sulfuric acid plants, nitrated organic chemicals, chlorophenols, benzyl chloride, PCBs, hydrogenated products, phosphorus halides, phosphoric acid, potassium phenyl acetate (1950), monochloroacetic acid (1951), tricresyl phosphate (1954), adipic acid (1954), phosphorus pentasulfide (1955), fatty acid chloride (1956), Santolubeâ 393 (1956), germicide and an oil additive, chlorinated cyanuric acid compounds ortho-dichlorobenzene calcium benzene sulfonate (Santolube® 290), aroclor, nitrochlorobenzene and ortho-nitrophenol The plant is under an Administrative Order on Consent under the Resource Conservation and Recovery Act to undertake corrective action which in part includes groundwater contamination at the facility

18. Sampling data has detected a wide variety of organic constituents in Sauget Areas 1 and 2, and the W.G. Krummrich Plant. This sampling includes the following results:

a. Site O:

1) Constituents detected in subsurface soils (E&E 1998) include, but are not limited to, 1,2-dichloroethane, 1,1,1-trichloroethane, trichloroethene, benzene, 4-Methyl-2-pentanone, toluene, chlorobenzene, ethylbenzene, total xylenes, 1,4-dichlorobenzene, 1,2-dichlorobenzene, 1,2,4-trichlorophenol, naphthalene, 2-methylnaphthalene, acenaphthene and PCBs.

2) Constituents detected in groundwater (E&E 1998) at Site O include, but are not limited to, methylene chloride, trans-1,2-dichloroethene, 2-butanone, trichloroethene, benzene, 4-methyl-2-pentanone, tetrachloroethene, 1,1,2,2-tetrachloroethane, toluene, chlorobenzene, phenol, 1,4-dichlorobenzene, 1,2-dichlorobenzene, 4-methylphenol, 4-chloroaniline,

b. Site Q (dog leg):

1) Constituents detected in soils at Site Q (dogleg) (E&E 1998) include, but are not limited to, benzene, 2,4-dimethylphenol, 1,4-dichlorobenzene, nitrobenzene, bis(2-ethylhexyl)phthalate, di-n-butyl phthalate, analine, chlorobenzene, ethylbenzene, toluene, 4-methyl-2-pentanone, o-xylene, and PCBs.

2) Constituents detected in groundwater at Site Q (dogleg) include, but are not limited to, 1,2-dichloroethane, 1,2-dichlorobenzene, benzene, 4-Methyl-2-pentanone, 2-hexanone, toluene, chlorobenzene, phenol, 2-chlorophenol, 4-methylphenol, 2,4-dimethylphenol, 2,4-dichlorophenol, 4-chloroaniline, 2,4,6-trichlorophenol, 2-nitroaniline, acenaphthylene, and pentachlorophenol.

c. Site R:

1) Constituents detected in soils at Site R include (Geraghty & Miller, 1994), but are not limited to, methylene chloride, acetone, 1,1 dichloroethene, chloroform, 1,2-dichloroethane, 2-butanone, 1,1,1-trichloroethane, bromodichloroethane, trichloroethene, dibromochloroethane, benzene, 4-methyl-2-pentanone, tetrachloroethene, toluene, chlorobenzen, ethylbenzene, xylenes, phenol, 2-chlorophenol, 1,3-dichlorobenzene, 1,4-dichlorobenzene, 1,2-dichlorobenzene, nitrobenzene, 2,4-dichlorophenol, 1,2,4-trichlorobenzene, naphthalene, 4-chloroaniline, 2-methylnaphthalene, 2,4,6-trichlorophenol, 2-nitroaniline, 4-nitroaniline, pentachlorophenol, aniline, 2-chloroaniline, 3-chloroaniline, and PCBs,

2) Constituents detected in groundwater at Site R (Geraghty & Miller, 1994 and Solutia, 2000) include, but are not limited to, acetone, benzene, chlorobenzene, 1,4-Dichlorobenzene, 1,2-dichloroethane, toluene, tetrachloroethene, 4-methyl-2-

Pentanone, aniline, naphthalene, nitrobenzene, phenol, 2,4-dichlorophenol, 2-chloroaniline, 2-chlorophenol, 2-nitrochlorobenzene, 3-chloroaniline, 3-nitochlorobenzene, 4-chloroaniline, 4-chlorophenol, 4-nitrochlorobenzene.

d. Site S:

1) Constituents detected in soils at Site S (E&E, 1998) include, but are not limited to 2-butanone, trichloroethene, 1,1,1-trichloroethane, 4-methyl-2-pentanone, toluene, ethylbenzene, total xylenes, naphthalene, di-n-butyl phthalate, di-n-octyl phthalate, butyl benzyl phthalate, bis(2-ethylhexyl)phthalate, and PCBs.

2) No groundwater data is available for Site S.

e Site I:

1) Constituents detected in soils at Site I (E&E 1998) include, but are not limited to, benzene, tetrachloroethene, toluene, chlorobenzene, 1,1,1-trichloroethane, ethylbenzene, total xylenes, nitrosodiphenylamine, hexachlorobenzene, pentachlorophenol, phenanthrene, anthracene, di-n-butyl-phthalate, fluoranthene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, 1,2-dichlorobenzene, benzoic acid, 1,2,4-trichlorobenzene, naphthalene, 4-chloroaniline, 2-methylnaphathalene, and acenaphthene.

2) Constituents detected in groundwater at Site I (U.S. EPA/Solutia, 2002) include, but are not limited to, benzene, chlorobenzene, 1,1-dichloroethene, cis/trans-1,2-dichloroethene, 1,4-dichlorobenzene, 4-chloroaniline, 2-chlorophenol, 2,4-dichlorophenol, 1,2,4-trichlorobenzene, n-nitrosodiphenylamine, Alpha-BHC, Delta-BHC.

f Clayton Chemical Facility

1) Constituents detected in groundwater at the Clayton Chemical facility (U S EPA START, 2001) include, but are not limited to vinyl chloride, 1,1,1-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, 1,1,1-trichloroethane, 1,2-dichloroethane, benzene, trichloroethene, toluene, tetrachloroethene, and xylene

g. W G Krummrich Facility:

1) Constituents detected in soils at the W G Krummrich Facility include (Solutia 2000), but are not limited to benzene, chlorobenzene, chlorotoluene, ethylbenzene, xylene, chloroaniline, dichlorobenzene, trichlorobenzene, pentachlorophenol, tert-butylbenzene, toluene, dichlorophenol, nitrobenzene, trichlorophenol

2) Constituents detected in groundwater at the W G Krummrich Facility include (Solutia 2000), but are not limited to dichlorobenzene, benzene, chlorobenzene, xylene, chloroaniline, toluene, ethylbenzene, nitrophenol, pentachlorophenol,

dichlorophenol, chlorophenol, trichlorobenzene, trichlorophenol, phenol, nitroaniline, methylene chloride, methyl isobutyl ketone, 1,1,1-trichloroethane, napthalene, 1,2-dichloroethene, vinyl chloride, nitrobenzene, nitrobiphenyl.

19. On information and belief, the Respondents set out below (as more fully identified in Attachment 1) generated wastes which were disposed of, released into and/or transported to the above-referenced facilities, as follows:

a. Site O: Rogers Cartage Company, Midwest Rubber Reclaiming (Division of Empire Chem., Inc.), Amax Zinc Corporation, Mobil Oil Corporation, Monsanto Chemical Company, Ethyl Corporation, Ethyl Petroleum Additives, Inc., and Clayton Chemical Co. (Division of Emerald Environmental, LLC.), Cerro Copper Products Company, Blue Tee Corp., Gold Fields American Corporation, American Zinc, Lead and Smelting Company; American Zinc Company, and Wiese Planning and Engineering.

b. Sites Q and/or R: Monsanto Chemical Company, Barry Weinmiller Steel Fabrication, Crown Cork & Seal Company, Inc., Dennis Chemical Company, Inc., Inmont Corporation, U.S. Paint Corporation, Kerr McGee Chemical Corporation, Dow Chemical, Mallinckrodt Chemical, Myco-Gloss, Clayton Chemical Company, United Technologies Corporation, AALCO Wrecking Company, Inc., Abco Trash Service & Equip. Company, Able Sewer Service, Ajax Hickman Hauling, Amax Zinc, Atlas Service Company, Banjo Iron Company, Becker Iron & Metal Corporation, Belleville Concrete Cont. Company, Bi-State Parks Airport, Bi-State Transit Company, Boyer Sanitation Service, Browning-Ferris Industries of St. Louis, C&E Hauling, Cargill Inc., Century Electric Company, Circle Packing Company, Corkery Fuel Company, David Hauling, State of Illinois Department of Transportation, Disposal Service Company, Dore Wrecking Company, Dotson Disposal "All" Service, Edgemont Construction, Edwin Cooper Inc., Eight & Trendy Metal Company, Evans Brothers, Finer Metals Company, Fish Disposal, Fruin-Colnon Corporation, Gibson Hauling, H.C. Fournie Inc., H.C. Fournie Plaster, Hilltop Hauling, Huffmeier Brothers, Hunter Packing Company, Lefton Iron & Metal Company, Midwest Sanitation, Mississippi Valley Control, Obear Nestor, Roy Baur, Thomas Byrd, and Trash Men Inc.

c. Site S: Clayton Chemical Co. (Division of Emerald Environmental, LLC.).

NON SITE-SPECIFIC GENERATORS/TRANSPORTERS: Rogers Cartage Company, Browning Ferris Industries, Inc., Browning Ferris Industries of St. Louis, Inc., C&E Hauling Company, Disposal Services Company, Hilltop Hauling, Inc., Paul Sauget, and National Vendors.

d. Site I: Monsanto Corporation/Solutia. Incorporated; Cerro Copper Products Company; Cardinal Construction Company; Amax Zinc Corporation; and Mobil Oil Corporation; Ethyl Petroleum; Village of Sauget; Olin Corporation.

20. On information and belief, the Respondents set out below own and/or operate or previously owned and/or operated portions of the above referenced facilities, as follows:

a. Site O: Village of Sauget and the Sauget Sanitary Development and Research Assn.

b. Site Q (dog leg): Alton & Southern Railroad, Village of Cahokia, Monsanto Company, Norfolk Southern Corporation, Notre Dame Fleeting and Towing Services, Patgood Inc., Phillips Pipe Line Company, Pillsbury Company (leasee), River Port Terminal and Fleeting Company, Village of Sauget, St. Louis Grain Company, Union Electric Company, Cahokia Trust Properties, Eagle Marine Industries Inc., Sauget & Company (c/o Paul Sauget), Industrial Salvage & Disposal Company, Clayton Chemical Company, Con-Agra, Inc., and Peavey Company.

c. Site R: Monsanto Chemical Company, Solutia, Inc., Cahokia Trust Properties and Sauget and Company.

d. Site S: A-1 Oil Corporation, Russell Bliss, Bliss Waste Oil Inc., Chemical Waste Management, Onyx Environmental Services, Norfolk Southern Corporation, Village of Sauget, Monsanto Chemical Company, and Clayton Chemical Co. (Division of Emerald Environmental LLC).

e. Site I: Monsanto Corporation/Solutia, Incorporated; Cerro Copper Products Company; Cardinal Construction Company; Amax Zinc Corporation; and Mobil Oil Corporation; Ethyl Petroleum; Village of Sauget; Olin Corporation.

f. Clayton Chemical Facility: Clayton Chemical, Emerald Environmental Group, LLC

g. W.G. Krummrich Facility: Monsanto Chemical Company, Solutia, Inc.

21. The Respondents identified in paragraphs 19 and 20 are collectively referred to as "Respondents."

22. The groundwater contamination down gradient from the Sauget Area 2 disposal sites O, Q (dog leg), R, and S; Sauget Area 1, Site I, Clayton Chemical, the W.G. Krummrich Plant and other industrial facilities is releasing to the Mississippi River and contaminating the river sediment. Groundwater is not a source of drinking water for area residents.

23. Solutia's contractors Dynamac Corporation and Geraghty & Miller prepared a Human Health risk assessment for Site R using data collected during an RI/FS required by an AOC with the Illinois Environmental Protection Agency (Illinois EPA). Based on these data, potential carcinogenic (cancer causing) risks for on-site workers and area residents consuming fish were

found to be within the acceptable risk range. For noncarcinogenic hazards, the values were also found to be within the acceptable risk range.

24. The Baseline Ecological Risk Assessment performed by Solutia's contractor Menzie-Cura, in 2001, which included sampling of surface water, sediment and fish tissue from the Mississippi River at and immediately down gradient of the OU, identified the following constituents of potential concern: acetone, benzene, 2-butanone, carbon disulfide, chlorobenzene, chloroethane, chloroform, 1,2-dichloroethane, cis-1,2-dichloroethene, ethylbenzene, methylene chloride, 4-methyl-2-pentanone, tetrachloroethylene, toluene, trans-1,2-dichloroethylene, trichloroethylene, vinyl chloride, xylenes, 4-bromophenylphenylether, 4-chloroaniline, 2-chlorophenol, 1,2-dichlorobenzene, 1,4-dichlorobenzene, 2,4-dichlorophenol, 2,4-dimethylphenol, 2,4-dinitrotoluene, 2-methylphenol, 3-methylphenol, 4-methylphenol, naphthalene, 2-nitroaniline, nitrobenzene, phenol, 2,4,6-trichlorophenol, alpha-BHC, alpha-chlordane, gamma-chlordane, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, dieldrin, endosulfan I, endrin, endrin aldehyde, heptachlor epoxide, 2,4-D, dicamba, dichloroprop, methyl chlorophenoxy propionic acid (MCPP), pentachlorophenol, 2,4,5-T, Silvex, and dioxin.

25. The findings of the Baseline Ecological Risk Assessment indicate that fish species in the Mississippi River adjacent to the OU are at a potential risk from exposure to contaminated sediment, and fish prey are at risk from exposure to surface water containing hazardous substances and constituents. The results of the risk assessment also indicate that fish are accumulating compounds, especially MCPP, detected in study area sediments, and identified a low potential risk to wildlife foraging on the media at and around the Site and the OU.

26. Based upon review of the currently available data for the OU and the findings from the Baseline Ecological Risk Assessment, it is the U.S. EPA's position that the preferred interim action identified in the ROD is necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

27. The Sauget Area 2 Site is currently the subject of a separate Administrative Order by Consent (AOC), signed by U.S. EPA and the members of the Sauget Area 2 Sites Group ("SA2SG") on November 24, 2000, requiring a Remedial Investigation and Feasibility Study (RI/FS) of Sauget Area 2 (which includes Sites O, P, Q, R and S). On November 14, 2001, U.S. EPA sent a Notification of Additional Work – Focused Feasibility Study, Groundwater Contamination Near Site R, Sauget Area 2 Site to the SA2SG. In response to U.S. EPA's November 14, 2001 Notification, Solutia Inc. ("Solutia") submitted a Focused Feasibility Study (FFS) to U.S. EPA on April 1, 2002 (the other members of the SA2SG declined to participate in the preparation and submittal of the FFS).

28. Pursuant to Section 117 of CERCLA, 42 U.S.C. § 9617, U.S. EPA published notice of the completion of the FFS and of the proposed Interim Groundwater Remedy on June 17, 2002, and provided opportunity for public comment on the proposed Interim Groundwater Remedy. U.S. EPA held a public meeting to discuss the remedy and to take comments on June 24, 2002 at the Sauget Village Hall.

29. The decision by U.S. EPA on the implementation of the Interim Groundwater Remedy is embodied in a Record of Decision ("ROD"), executed on September 30, 2002, on which the Illinois EPA has given its concurrence. The ROD includes a Responsiveness Summary addressing comments on the proposed plan made by the public and the PRPs. The ROD is an enforceable part of this Order and is attached hereto as Attachment 2. The ROD is supported by an Administrative Record which contains the documents and information upon which U.S. EPA based the selection of the response action. The U.S. EPA's selected response action set out in the ROD has been determined to provide adequate protection of public health, welfare, and the environment; to meet all federal and State environmental laws; and to be cost effective.

30. The selected remedy of the ROD includes the installation of a 3,500 foot long, "U"-shaped, fully penetrating, jet grout barrier wall to be installed between the down gradient boundary of Sauget Area 2 Site R and the Mississippi River, institutional controls, groundwater recovery wells, the discharge and treatment of extracted groundwater, and groundwater quality monitoring, groundwater level monitoring, and sediment and surface water monitoring.

31. The preferred alternative is considered an interim remedial action for the groundwater operable unit at the Sauget Area 2 Site. This limited-scope action is intended only to address the release of contaminated groundwater into the Mississippi River in the vicinity of the OU. Operation of the physical barrier and groundwater extraction system will provide additional information to be used in developing options for a final long-term comprehensive groundwater remedy for Sauget Area 2. A final response action to address fully the threats posed by conditions at the Sauget Area 2 Site will be taken upon completion of the Sauget Area 2 RI/FS in 2004.

32. Groundwater contamination releasing to the Mississippi River adjacent to Site R and the resulting impact area is a "facility" as that term is defined by Section 101(9) of CERCLA, 42 U.S.C. § 9601(9).

33. Each Respondent is a "person" as defined by Section 101(21) of CERCLA, 42 U.S.C. § 9601(21).

34. Each Respondent is a "liable party" as defined in Section 107(a) of CERCLA, 42 U.S.C. § 9607(a), and is subject to this Order under Section 106(a) of CERCLA, 42 U.S.C. § 9606(a).

35. "Hazardous substances" as defined by Section 101(14) of CERCLA, 42 U.S.C. § 9601(14) are present at the OU

36. The conditions described in Section IV Determinations above constitute an actual "release" into the "environment" as defined by Sections 101(8) and (22) of CERCLA, 42 U.S.C. §§ 9601(8) and (22).

37. The actual or threatened release of hazardous substances from the OU may present an imminent and substantial endangerment to the public health, welfare, or the environment within the meaning of Section 106(a) of CERCLA, 42 U.S.C. § 9606(a).

38. The interim remedial action required by this Order is necessary to protect the public health, welfare, or the environment, and is not inconsistent with the NCP and CERCLA.

V. NOTICE TO THE STATE

39. U.S. EPA has notified the State of Illinois, Illinois EPA, that U.S. EPA intends to issue this Order. U.S. EPA will consult with the State and the State will have the opportunity to review and comment to U.S. EPA regarding all work to be performed, including remedial design, reports, technical data and other deliverables, and any other issues which arise while the Order remains in effect.

VI. ORDER

40. Based on the foregoing, each Respondent is hereby ordered to comply with all of the provisions of this Order, including but not limited to all attachments to this Order, all documents incorporated by reference into this Order, and all schedules and deadlines contained in this Order, attached to this Order, or incorporated by reference into this Order.

VII. WORK TO BE PERFORMED

41. Within five (5) days after the effective date of this Order, each Respondent that owns real property comprising any part of the Site shall record Notice of and/or a copy of this Order in the appropriate governmental office where land ownership and transfer records are filed or recorded, and shall ensure that the recording of said notice and/or Order is indexed to the title of each and every parcel of property owned by said Respondent at the Site, so as to provide notice to third parties of the issuance and terms of this Order with respect to those properties. Respondents shall, within 15 days after the effective date of this Order, send notice of such recording and indexing to U.S. EPA.

42. All workplans, reports, engineering design documents, and other deliverables (workplans and deliverables), as described throughout this Order, shall be submitted to Illinois EPA (except documents claimed to contain confidential business information) and U.S. EPA. All workplans and deliverables will be reviewed and either approved, approved with modifications, or disapproved by U.S. EPA, in consultation with Illinois EPA. In the event of approval or approval with modifications by U.S. EPA, Respondents shall proceed to take any action required by the workplan, report, or other item, as approved or modified by U.S. EPA. If the workplan or other deliverable is approved with modifications or disapproved, U.S. EPA will provide, in writing, comments or modifications required for approval. Respondents shall amend the workplan or other deliverable to incorporate only those comments or modifications required by U.S. EPA. Within twenty-one (21) days of the date of U.S. EPA's written notification of approval with modifications or disapproval, Respondents shall submit an amended workplan or other deliverable. U.S. EPA shall review the amended workplan or deliverable and either approve or disapprove it. Failure to submit a workplan, amended workplan or other deliverable shall constitute noncompliance with this Order. Submission of an amended workplan or other

deliverable which fails to incorporate all of U.S. EPA's required modifications, or which includes other unrequested modifications, shall also constitute noncompliance with this Order. Approval by U.S. EPA of the (amended) workplan or other deliverable shall cause said approved (amended) workplan or other deliverable to be incorporated herein as an enforceable part of this Order. If any (amended) workplan or other deliverable is not approved by U.S. EPA, Respondents shall be deemed to be in violation of this Order.

43. In the event of an inconsistency between this Order and any subsequent approved (amended) workplan or other deliverable, the terms of this Order shall control.

A. RD/RA Workplan

44. Within forty-five (45) days after the effective date of this Order, Respondents shall submit a workplan for the remedial design and remedial action "(RD/RA Workplan") for the OU to U.S. EPA for review and approval.

45. The RD portion of the RD/RA Workplan shall include a detailed step-by-step plan for completing the remedial design for the interim groundwater remedy selected in the ROD, and for attaining and maintaining all requirements and performance standards identified in the ROD and Statement of Work. The RD portion of the RD/RA Workplan shall describe in detail the tasks and deliverables Respondents will complete during the remedial design phase, and a schedule for completing the tasks and deliverables relating to the RD. The RD portion of the RD/RA Workplan shall be consistent with and provide for implementation of the Statement of Work, and shall comport with U.S. EPA's "Superfund Remedial Design and Remedial Action Guidance, OSWER Directive 9355.0-4A" and any amendments to this guidance. The RD portion of the RD/RA Workplan shall include a Sampling and Analysis Plan and a Quality Assurance Project Plan for U.S. EPA review. Respondents shall also submit a Health and Safety Plan for all pre-design sampling efforts, including treatability studies, which shall be consistent with the Occupational Safety and Health Act (OSHA). The major tasks and deliverables described in the RD portion of the RD/RA Workplan shall include, but not be limited to, the following: (1) a pre-final design; including results of field sampling and treatability studies; and (2) a final design. At each of these design completion stages, the design packages shall include the items as described in Task 2 of the attached Statement of Work.

46. The RA portion of the RD/RA Workplan shall be developed in accordance with the ROD and the Statement of Work, and shall be consistent with the final design as approved by U.S. EPA. The RA portion of the RD/RA Workplan shall include methodologies, plans, and schedules for completion of at least the following: (1) selection of the remedial action contractor; (2) implementation of a Construction Quality Assurance Plan; (3) identification of and satisfactory compliance with applicable permitting requirements, if any; (4) implementation of the Operation and Maintenance Plan; (5) implementation of the Contingency Plan; and (6) implementation of the ground water, surface water, and sediment monitoring plans. The RA portion of the RD/RA Workplan shall include a schedule for implementing all remedial action tasks identified in the Statement of Work and shall identify the initial formulation of Respondent's remedial action project team, including the supervising contractor Respondents shall also submit to U.S. EPA a

Health and Safety Plan for field activities required by the RD/RA Workplan. The Health and Safety Plan for field activities shall conform to applicable Occupational Safety and Health Administration and U.S. EPA requirements, including but not limited to the regulations at 54 Fed. Reg. 9294.

47. Upon approval of the (Amended) RD/RA Workplan by U.S. EPA, Respondents shall implement the (Amended) RD/RA Workplan in accordance with any and all instructions from the RPM and in accordance with the schedules in the (Amended) RD/RA Workplan. Unless otherwise directed by U.S. EPA, Respondents shall not commence remedial action at the OU prior to approval of the (Amended) RD/RA Workplan. Any noncompliance with the approved (Amended) RD/RA Workplan shall be a violation of this Order.

48. The work performed by Respondents pursuant to this Order shall, at a minimum, achieve the performance standards specified in the Record of Decision and the Statement of Work. Nothing in this Order, or in U.S. EPA's approval of any (amended) workplan or other deliverable, shall be deemed to constitute a warranty or representation of any kind by U.S. EPA that full performance of the remedial design or remedial action will achieve the performance standards set forth in the ROD and in the Statement of Work. Respondents' compliance with such approved documents does not foreclose U.S. EPA from seeking additional work.

49. All materials removed from the Facility shall be disposed of or treated at a facility approved in advance of removal by U.S. EPA's RPM and in accordance with: 1) Section 121(d)(3) of CERCLA, 42 U.S.C. § 9621(d)(3); 2) the Resource Conservation and Recovery Act of 1976 (RCRA), 42 U.S.C. § 6901, et seq., as amended; 3) the U.S. EPA Off-Site Rule 40 CFR § 300.440; and 4) all other applicable federal, State, and local requirements. The identity of the receiving facility and state will be determined by Respondents following the award of the contract for remedial action construction. Respondents shall provide written notice to the RPM which shall include all relevant information, including the information required by paragraph 62 below, as soon as practicable after the award of the contract and before the hazardous substances are actually shipped off-site.

50. Prior to any off-site shipment of hazardous substances from the OU to an out-of-state waste management facility, Respondents shall provide written notification to the appropriate state environmental official in the receiving state and to U.S. EPA's RPM of such shipment of hazardous substances. However, the notification of shipments to the state shall not apply to any off-site shipments when the total volume of all shipments from the site to the state will not exceed ten (10) cubic yards. The notification shall be in writing, and shall include the following information, where available: (1) the name and location of the facility to which the hazardous substances are to be shipped; (2) the type and quantity of the hazardous substances to be shipped; (3) the expected schedule for the shipment of the hazardous substances; and (4) the method of transportation. Respondents shall notify the receiving state of major changes in the shipment plan, such as a decision to ship the hazardous substances to another facility within the same state, or to a facility in another state.

51. Respondents shall cooperate with U.S. EPA in providing information regarding the work to the public. When requested by U.S. EPA, Respondents shall participate in the preparation of such information for distribution to the public and in public meetings which may be held or sponsored by U.S. EPA to explain activities at or relating to the OU.

52. Within 30 days of a successful final inspection, Settling Defendants shall submit a Construction Completion Report. In the report, a registered professional engineer and the Settling Defendants' Project Coordinator shall certifying that the remedial action has been completed in full satisfaction of the requirements of this Order. The written report shall include as-built drawings signed and stamped by a professional engineer. If, after review of the Construction Completion Report, U.S. EPA determines that the remedial action or any portion thereof has not been completed in accordance with this Order, U.S. EPA shall notify Respondents in writing of the activities that must be undertaken to complete the remedial action and shall set forth in the notice a schedule for performance of such activities. Respondents shall perform all activities described in the notice in accordance with the specifications and schedules established therein. If U.S. EPA concludes, following the initial or any subsequent certification of completion by Respondents that the remedial action has been fully performed in accordance with this Order, U.S. EPA may notify Respondents that the remedial action has been fully performed. U.S. EPA's notification shall be based on present knowledge and Respondent's certification to U.S. EPA, and shall not limit U.S. EPA's right to perform periodic reviews pursuant to § 121(c) of CERCLA, 42 U.S.C. § 9621(c), or to take or require any action that in the judgment of U.S. EPA is appropriate at the site, in accordance with 42 U.S.C. §§ 9604, 9606, or 9607.

VIII. PERIODIC REVIEW

53. Under § 121(c) of CERCLA, 42 U.S.C. § 9621(c), and any applicable regulations, where hazardous substances will remain on site at the completion of the remedial action, U.S. EPA may review the OU to assure that the work performed pursuant to this Order adequately protects human health and the environment. Until such time as U.S. EPA certifies completion of the work, Respondents shall conduct the requisite studies, investigations, or other response actions as determined necessary by U.S. EPA in order to permit U.S. EPA to conduct the review under § 121(c) of CERCLA. As a result of any review performed under this paragraph, Respondents may be required to perform additional work or to modify work previously performed.

IX. ASSURANCE ABILITY TO COMPLETE WORK

54. Within 30 days of the effective date of this Order, the Respondents shall establish assurance of its ability to complete the work herein in one or more of the following forms:

a. A surety bond guaranteeing performance of the Work;

b. One or more irrevocable letters of credit equaling the total estimated cost of the Work ($26,500,000);

c. A trust fund;

d. A guarantee to perform the Work by one or more parent corporations or subsidiaries, or by one or more unrelated corporations that have a substantial business relationship with at least one of the Respondents;

e. A demonstration that one or more of the Respondents satisfy the requirements of 40 C.F.R. Part 264.143(f).

f. Submittal to U.S. EPA of annual reports of each of the Respondents which are publicly-traded on the New York Stock Exchange. Until U.S. EPA has issued a Certification of Completion of the Interim Remedial Action pursuant to the Paragraph 98, each of the publicly-traded Respondents shall continue to submit an annual report for the corresponding year each year on the anniversary date of the issuance of Order.

55. If the Respondents seek to demonstrate the ability to complete the Work through a guarantee by a third party, Respondents shall demonstrate that the guarantor satisfies the requirements of 40 C.F.R. Part 264.143(f). If Respondents seek to demonstrate their ability to complete the Work by means of the financial test or the corporate guarantee pursuant to this Section they shall resubmit sworn statements conveying the information required by 40 C.F.R. Part 264.143(f) annually, on the anniversary of the effective date. In the event that U.S. EPA, (after a reasonable opportunity for review and comment by the State), determines at any time that the financial assurances provided pursuant to this Section are inadequate, Respondents shall, within 30 days of receipt of notice of EPA's determination, obtain and present to EPA for approval one of the other forms of financial assurance listed in this Section of this Order. Respondents' inability to demonstrate financial ability to complete the Work shall not excuse performance of any activities required under this Order.

56. If Respondents can show that the estimated cost to complete the remaining Work has diminished below the amount set forth in this Section above after entry of this Order, Respondents may, on any anniversary date of entry of this Order, or at any other time agreed to by the Parties, reduce the amount of the financial security provided under this Section to the estimated cost of the remaining work to be performed. Respondents shall submit a proposal for such reduction to U.S. EPA, in accordance with the requirements of this Section, and may reduce the amount of the security upon approval by EPA. In the event of a dispute, Respondents may reduce the amount of the security in accordance with the final administrative or judicial decision resolving the dispute.

57. Respondents may change the form of financial assurance provided under this Section at any time, upon notice to and approval by U.S. EPA, provided that the new form of assurance meets the requirements of this Section. In the event of a dispute, Respondents may change the form of the financial assurance only in accordance with the final administrative or judicial decision resolving the dispute.

X. ADDITIONAL RESPONSE ACTIONS

58. In the event that U.S. EPA determines that additional work or modifications to work are necessary to meet performance standards, to maintain consistency with the final remedy, or to otherwise protect human health or the environment, U.S. EPA will notify Respondents that additional response actions are necessary. U.S. EPA may also require Respondents to modify any plan, design, or other deliverable required by this Order, including any approved modifications.

59 Within thirty (30) days of receipt of notice from U S EPA that additional response activities are necessary, Respondents shall submit for approval an Additional RD/RA Workplan pursuant to paragraph 42 herein The Additional RD/RA Workplan shall conform to this Order's requirements for RD and RA Workplans Upon U S EPA's approval of the (Amended) Additional RD/RA Workplan, the (Amended) Additional RD/RA Workplan shall become an enforceable part of this Order, and Respondents shall implement the (Amended) Additional RD/RA Workplan for additional response activities in accordance with the standards, specifications, and schedule contained therein Failure to submit an Additional RD/RA Workplan shall constitute noncompliance with this Order

XI ENDANGERMENT AND EMERGENCY RESPONSE

60 In the event of any event during the performance of the work which causes or threatens to cause a release of a hazardous substance or which may present an immediate threat to public health or welfare or the environment, Respondents shall immediately take all appropriate action to prevent, abate, or minimize the threat, and shall immediately notify U S EPA's RPM or alternate RPM If neither of these persons is available Respondents shall notify the Regional Deputy Officer, U S EPA Emergency Response Branch, Region 5, at (312) 353-2318 Respondents shall take further action in consultation with U S EPA's RPM and in accordance with all applicable provisions of this Order, including but not limited to the health and safety plan and the contingency plan In the event that Respondents fails to take appropriate response action as required by this paragraph, and U S EPA takes that action instead, Respondents shall reimburse U S EPA for all costs of the response action not inconsistent with the NCP Respondents shall pay the response costs in the manner described in section XX (reimbursement of response costs) of this Order, within thirty (30) days of U S EPA's demand for payment

61 Nothing in the preceding paragraph 60 shall be deemed to limit any authority of the United States to take, direct, or order all appropriate action to protect human health and the environment or to prevent, abate, or minimize an actual or threatened release of hazardous substances on, at, or from the OU or the Site

XII PROGRESS REPORTS

62 In addition to the other deliverables set forth in this Order, Respondents shall provide monthly progress reports to U S EPA and Illinois EPA with respect to actions and activities undertaken pursuant to this Order The progress reports shall be submitted on or before the 10th day of each month following the effective date of this Order Respondents' obligation to submit progress reports continues until U S EPA gives Respondents written notice under paragraph 98 of this Order At a minimum these progress reports shall (1) describe the actions which have been taken to comply with this Order during the prior month, (2) include all results of sampling and tests and all other data received by Respondents and not previously submitted to U S EPA, (3) describe all work planned for the next 90-days with schedules relating such work to the overall project schedule for RD/RA completion, and (4) describe all problems encountered and any anticipated problems, any actual or anticipated delays and solutions developed and implemented to address any actual or anticipated problems or delays

XIII QUALITY ASSURANCE, SAMPLING AND DATA ANALYSIS

63 Respondents shall use the quality assurance, quality control, and chain of custody procedures described in the "U S EPA NEIC Policies and Procedures Manual," May 1978, revised May 1986, U S EPA-330/9-78-001-R, U S EPA's "Guidelines and Specifications for Preparing Quality Assurance Program Documentation," June 1, 1987, U S EPA's "Data Quality Objective Guidance," (U S EPA/540/G87/003 and 004), and any amendments to these documents, while conducting all sample collection and analysis activities required herein by any plan To provide quality assurance and maintain quality control, Respondents shall do the following

a Prior to the commencement of any sampling and analysis under this Order, Respondents shall submit a Quality Assurance Project Plan (QAPP) to the U S EPA and Illinois EPA that is consistent with the SOW, (amended) workplans, U S EPA's "Interim Guidelines and Specifications For Preparing Quality Assurance Project Plans" (QAM-OO5/8O), and any subsequent amendments,

b Prior to the development and submittal of a QAPP, Respondents shall attend a pre-QAPP meeting sponsored by U S EPA to identify all monitoring and data quality objectives U S EPA, after review of the submitted QAPP, will either approve, conditionally approve, or disapprove the QAPP Upon notification of conditional or disapproval, Respondents shall make all required modifications to the QAPP within twenty-one (21) days of receipt of such notification

c Respondents shall use only laboratories which have a documented Quality Assurance Program that complies with U S EPA guidance document QAMS-005/80 and subsequent amendments

d Ensure that the laboratory used by the Respondents for analyses, performs according to a method or methods deemed satisfactory to U S EPA and submits all protocols to be used for analyses to U S EPA at least 30 days before beginning analysis

e Ensure that U S EPA personnel and U S EPA's authorized representatives are allowed access to the laboratory and personnel utilized by the Respondents for analyses

64 Respondents shall notify U S EPA and Illinois EPA not less than fourteen (14) days in advance of any sample collection activity At the request of U S EPA, Respondents shall allow U S EPA or its authorized representatives to take split or duplicate samples of any samples collected by Respondents with regard to the OU or pursuant to the implementation of this Order In addition, U S EPA shall have the right to take any additional samples that U S EPA deems necessary

XIV COMPLIANCE WITH APPLICABLE LAWS

65 All activities by Respondents pursuant to this Order shall be performed in accordance with the requirements of all federal and State laws and regulations U S EPA has determined that the activities contemplated by this Order are consistent with the National Contingency Plan

66 Except as provided in § 121(e) of CERCLA and the NCP, no permit shall be required for any portion of the work conducted entirely on-site Where any portion of the work requires a federal or State permit Respondents shall submit timely applications and take all other actions necessary to obtain and to comply with all such permits or approvals

67 This Order is not and shall not be construed to be, a permit issued pursuant to any federal or State statute or regulation

XV REMEDIAL PROJECT MANAGER (RPM)

68 All communications, whether written or oral, from Respondents to U S EPA shall be directed to U S EPA's RPM Respondents shall submit to U S EPA three (3) copies of all documents, including plans, reports, and other correspondence, which are developed pursuant to this Order, and shall send these documents by certified mail, return receipt requested postmarked no later than the relevant due date of such documents.
U S EPA's RPM is

Mike Ribordy
77 West Jackson Blvd , SR-6J
Chicago, IL 60604-3590
(312) 886-4592

U S EPA's Alternate RPM is
Ross Del Rosario
77 West Jackson Blvd , SR-6J
Chicago, IL 60604-3590

The State Agency contact person is
Sandra Bron
Illinois EPA
Bureau of Land
1021 North Grand Avenue East
P O Box 19276
Springfield, IL 62794-9276
(217) 557-3199

69 U S EPA may change its RPM or Alternate RPM If U S EPA changes its RPM or Alternate RPM, U S EPA will inform Respondents in writing of the name, address, and telephone number of the new RPM or Alternate RPM

70 U S EPA's RPM and Alternate RPM shall have the authority lawfully vested in an RPM and On-Scene Coordinator (OSC) by the National Contingency Plan U S EPA's RPM or Alternate RPM shall have authority, consistent with the NCP, to halt any work required by this Order, and to take any necessary response action

XVI PROJECT COORDINATOR AND CONTRACTORS

71 All aspects of the Work to be performed by Respondents pursuant to this Order shall be under the direction and supervision of a Project Coordinator qualified to undertake and complete the requirements of this Order The Project Coordinator shall be the RPM's primary point of contact with the Respondents and shall possess sufficient technical expertise regarding all aspects of the work. Within fifteen (15) days after the effective date of this Order, Respondents shall notify U S. EPA in writing of the name and qualifications of the Project Coordinator, including primary support entities and staff, proposed to be used in carrying out work under this Order. U.S EPA reserves the right to disapprove the proposed Project Coordinator.

72 Within thirty (30) days after U S EPA approves the Final Design, Respondents shall identify a proposed construction contractor and notify U S EPA in writing of the name, title, and qualifications of the construction contractor proposed to be used in carrying out work under this Order.

73. Respondents shall submit a copy of the construction contractor solicitation documents to U.S. EPA not later than five (5) days after publishing the solicitation documents. Upon U.S. EPA's request, Respondents shall submit complete copies of all bid packages received from all contract bidders

74 At least seven (7) days prior to commencing any work at the OU pursuant to this Order, Respondents shall submit to U S EPA a certification that Respondents or their contractors and subcontractors have adequate insurance coverage or have indemnification for liabilities for injuries or damages to persons or property which may result from the activities to be conducted by or on behalf of Respondents pursuant to this Order. Respondents shall ensure that such insurance or indemnification is maintained for the duration of the work required by this Order

75. U S EPA retains the right to disapprove of the Project Coordinator and any contractor, including but not limited to remedial design contractors and construction contractors retained by the Respondents In the event U S EPA disapproves a Project Coordinator or contractor, Respondents shall retain a new project coordinator or contractor to perform the work, and such selection shall be made within fifteen (15) days following the date of U S EPA's disapproval If at any time Respondents propose to use a new project coordinator or contractor, Respondents shall notify U S EPA of the identity of the new project coordinator or contractor at least fifteen (15) days before the new project coordinator or contractor performs any work under this Order

XVII SITE ACCESS AND DOCUMENT AVAILABILITY

76 In the event that the OU, the off-site areas that is to be used for access, property where documents required to be prepared or maintained by this Order are located, or other property subject to or affected by this response action, is owned in whole or in part by parties other than those bound by this Order, Respondents will obtain, or use their best efforts to obtain, site access agreements from the present owner(s), within sixty (60) days of the effective date of this Order Said agreements shall provide access for U S EPA, its contractors and oversight officials, the State and its contractors and Respondents or Respondents authorized representatives and

contractors. Said agreements shall specify that Respondents are not U.S. EPA's representative with respect to liability associated with site activities. Copies of such agreements shall be provided to U.S. EPA prior to Respondents' initiation of field activities. Respondents' best efforts shall include providing reasonable compensation to any off-site property owner. If access agreements are not obtained within the time referenced above, Respondents shall immediately notify U.S. EPA of its failure to obtain access.

77. If Respondents cannot obtain the necessary access agreements, U.S. EPA may exercise non-reviewable discretion and; (1) use its legal authorities to obtain access for the Respondents; (2) conduct response actions at the property in question; or (3) terminate this Order. If U.S. EPA conducts a response action and does not terminate the Order, Respondents shall perform all other activities not requiring access to that property. Respondents shall integrate the results of any such tasks undertaken by U.S. EPA into its reports and deliverables. Respondents shall reimburse U.S. EPA pursuant to Section XX of this Order (Reimbursement of Response Costs) for all response costs (including attorney fees) incurred by the United States to obtain access for Respondents.

78. Respondents shall allow U.S. EPA and its authorized representatives and contractors to enter and freely move about all property at the OU and off-site areas subject to or affected by the work under this Order or where documents required to be prepared or maintained by this Order are located, for the purposes of inspecting conditions, activities, the results of activities, records, operating logs, and contracts related to the OU or Respondents and its representatives or contractors pursuant to this Order; reviewing the progress of the Respondents in carrying out the terms of this Order; conducting tests as U.S. EPA or its authorized representatives or contractors deem necessary; using a camera, sound recording device or other documentary type equipment; and verifying the data submitted to U.S. EPA by Respondents. Respondents shall allow U.S. EPA and its authorized representatives to enter the OU site, to inspect and copy all records, files, photographs, documents, sampling and monitoring data, and other writings related to work undertaken in carrying out this Order. Nothing herein shall limit U.S. EPA's right of entry or inspection authority under federal law, and U.S. EPA retains all of its information gathering and enforcement authorities and rights under CERCLA, RCRA, and any other applicable statutes and regulations.

XVIII. RECORD PRESERVATION

79. On or before the effective date of this Order, Respondents shall submit a written certification to U.S. EPA that they have not altered, mutilated, discarded, destroyed or otherwise disposed of any records, documents or other information relating to their potential liability with regard to the OU site and OU source areas since the time of their notification of potential liability by U.S. EPA or the State. Respondents shall not dispose of any such documents without prior approval by U.S. EPA. Upon U.S. EPA's request, Respondents shall make all such documents available to U.S. EPA and shall submit a log of any such documents claimed to be privileged for any reason. This privilege log shall list, for each document, the date, author, addressees (including courtesy copies or "cc"s and "bcc"s) and subject matter of the document.

80. Respondents shall provide to U.S. EPA upon request, copies of all documents and information within their or their contractors, subcontractors or agents possession or control relating to activities at the OU or to the implementation of this Order, including but not limited to sampling, analysis, chain of custody records, manifests, trucking logs, receipts, reports, traffic routing, correspondence, or other documents or information. Respondents shall also make available to U.S. EPA their employees, agents, or representatives for purposes of investigation, information gathering or testimony concerning the performance of the work.

81. Until six (6) years after U.S. EPA provides notice pursuant to paragraph 98 of this Order, Respondents shall preserve, and shall instruct their contractors and agents to preserve, all documents, records, and information of whatever kind, nature or description relating to the performance of the work. Upon the conclusion of this document retention period, Respondents shall notify the United States at least ninety (60) days prior to the destruction of any such records, documents or information, and, upon request of the United States, Respondents shall deliver all such documents, records and information to U.S. EPA.

82. Respondents may assert a claim of business confidentiality covering part or all of the information submitted to U.S. EPA pursuant to the terms of this Order under 40 C.F.R. § 2.203, provided such claim is not inconsistent with Section 104(e)(7) of CERCLA, 42 U.S.C. § 9604(e)(7) or other provisions of law. This claim shall be asserted in the manner described by 40 C.F.R. § 2.203(b) and substantiated by Respondents at the time the claim is made. Information determined to be confidential by U.S. EPA will be given the protection specified in 40 C.F.R. Part 2. If no such claim accompanies the information when it is submitted to U.S. EPA, it may be made available to the public by U.S. EPA or the State without further notice to the Respondents. Respondents shall not assert confidentiality claims with respect to any data or documents related to site conditions, sampling, or monitoring.

83. Respondents shall maintain, for the period during which this Order is in effect, an index of documents that Respondents claim contain confidential business information ("CBI"). The index shall contain, for each document, the date, author, addressee, and subject of the document. Respondents shall submit an updated copy of the index to U.S. EPA with each new document(s) claimed to be CBI. The updated index shall also indicate any documents for which CBI claims have been withdrawn.

XIX. DELAY IN PERFORMANCE

84. Any delay in performance of this Order according to its terms and schedules that is not properly justified by Respondents under the terms of this section shall be considered a violation of this Order. Any delay in performance of this Order shall not affect Respondents obligations to fully perform all obligations under the terms and conditions of this Order.

85. Respondents shall notify U.S. EPA of any delay or anticipated delay in performing any requirement of this Order. Such notification shall be made by telephone to U.S. EPA's RPM or Alternate RPM within forty eight (48) hours after Respondents first knew or should have known that a delay might occur. Respondents shall adopt all reasonable measures to avoid or minimize

any such delay. Within seven (7) days after notifying U.S. EPA by telephone, Respondents shall provide written notification fully describing the nature of the delay, any justification for delay, any reason why Respondents should not be held strictly accountable for failing to comply with any relevant requirements of this Order, the measures planned and taken to minimize the delay, and a schedule for implementing the measures that will be taken to mitigate the effect of the delay. Increased costs or expenses associated with implementation of the activities called for in this Order is not a justification for any delay in performance.

XX. REIMBURSEMENT OF RESPONSE COSTS

86. Respondents shall reimburse U.S. EPA, upon written demand, for all response costs incurred by the United States in overseeing Respondent's implementation of the requirements of this Order. U.S. EPA may submit to Respondents on a periodic basis an accounting of all oversight response costs incurred by the United States with respect to this Order. U.S. EPA's Itemized Cost Summary Reports, or such other summary as may be certified by U.S. EPA, shall serve as the accounting and basis for payment demands.

87. Respondents shall, within thirty (30) days of receipt of each U.S. EPA accounting, remit a certified or cashier's check for the amount of those costs. Interest shall accrue from the later of the date that payment of a specified amount is demanded in writing or the date of the expenditure. The interest rate is the rate established by the Department of the Treasury pursuant to 31 U.S.C. § 3717 and 4 C.F.R. § 102.13.

88. Checks shall be made payable to the "U.S. EPA Hazardous Substances Superfund" and shall include the name of the Site and OU, the Site identification number ILD000605790, the account number 05XX and the title of this Order. Checks shall be forwarded to:

U.S. Environmental Protection Agency
Superfund Accounting
P.O. Box 70753
Chicago, Illinois 60673

Respondents shall send copies of each transmittal letter and check to the U.S. EPA's RPM.

XXI. UNITED STATES NOT LIABLE

89. The United States and U.S. EPA are not to be construed as parties to, and do not assume any liability for, any contract entered into by the Respondents to carry out the activities pursuant to this Order. The proper completion of the work under this Order is solely the responsibility of the Respondents. The United States and U.S. EPA, by issuance of this Order, also assume no liability for any injuries or damages to persons or property resulting from acts or omissions by Respondents, or (their) directors, officers, employees, agents, representatives, successors, assigns, contractors, or consultants in carrying out any action or activity required by this Order.

XXII. ENFORCEMENT AND RESERVATIONS

90. U.S. EPA reserves the right to bring an action against Respondents under Section 107 of CERCLA, 42 U.S.C. § 9607, for recovery of any response costs incurred by the United States related to this Order and not reimbursed by Respondents. This reservation shall include but not be limited to past costs, direct costs, indirect costs, the costs of oversight, the costs of compiling the cost documentation to support oversight cost demand, as well as accrued interest as provided in Section 107(a) of CERCLA.

91. Notwithstanding any other provision of this Order, at any time during the response action, U.S. EPA may perform its own studies, complete the response action (or any portion of the response action) as provided in CERCLA and the NCP, and seek reimbursement from Respondents for its costs, or seek any other appropriate relief.

92. Nothing in this Order shall preclude U.S. EPA from taking any additional enforcement actions, including modification of this Order or issuance of additional Orders, and/or additional remedial or removal actions as U.S. EPA may deem necessary, or from requiring Respondents in the future to perform additional activities pursuant to CERCLA, 42 U.S.C. § 9606(a), et seq., or any other applicable law. This Order shall not affect any Respondent's liability under CERCLA Section 107(a), 42 U.S.C. § 9607(a), for the costs of any such additional actions.

93. Notwithstanding any provision of this Order, the United States hereby retains all of its information gathering, inspection and enforcement authorities and rights under CERCLA, RCRA and any other applicable statutes or regulations.

94. Nothing in this Order shall constitute or be construed as a release from any claim, cause of action or demand in law or equity against any person for any liability it may have arising out of or relating in any way to the OU or the Site.

95. If a court issues an order that invalidates any provision of this Order or finds that Respondents have sufficient cause not to comply with one or more provisions of this Order, Respondents shall remain bound to comply with all provisions of this Order not invalidated by the court's order.

XXIII. ACCESS TO ADMINISTRATIVE RECORD

96 The Section 106 Administrative Record is available for review on normal business days between the hours of 9:00 a.m. and 5:00 p.m. at the U.S. EPA, Region 5, 77 West Jackson Boulevard Chicago, Illinois. An Index of the Administrative Record is attached hereto as Attachment 3.

XXIV EFFECTIVE DATE AND TERMINATION

97 This Order shall become effective thirty (30) days after the date of issuance

98 Within thirty (30) days after Respondents concludes that all phases of the work have been fully performed, that the performance standards have been attained, and that all operation and maintenance activities have been completed, Respondents shall submit to U S EPA a written report by a registered professional engineer certifying that the work has been completed in full satisfaction of the requirements of this Order U S EPA shall require such additional activities as may be necessary to complete the work or U S EPA may, based upon present knowledge and Respondent's certification to U S EPA, issue written notification to Respondents that the work has been completed, as appropriate, in accordance with the procedures set forth in paragraph 52 for Respondent's certification of completion of the remedial action U S EPA's notification shall not limit U S EPA's right to perform periodic reviews pursuant to Section 121(c) of CERCLA, 42 U S C § 9621(c), or to take or require any action that in the judgment of U S EPA is appropriate at the Site, in accordance with 42 U S C §§ 9604, 9606, or 9607 The provisions of this Order shall be deemed to be satisfied when U S EPA notifies Respondents in writing that Respondents have demonstrated, to U S EPA's satisfaction, that all terms of the Order have been completed This notice shall not, however, terminate Respondents obligation to comply with Section XVIII of this Order (Record Preservation)

XXV NOTICE OF INTENT TO COMPLY

99 On or before the effective date of this Order, each Respondent must submit to U S EPA a written notice stating its unequivocal intention to comply with all terms of this Order, together with the written notice required by paragraph 79 In the event any Respondent fails to provide said written notice of its unequivocal intention to comply with this Order on or before the effective date, said Respondent shall be deemed to have refused to comply with this Order A Respondent which fails to provide timely notice of its intent to comply with this Order shall thereafter have no authority to perform any response action at the Site, pursuant to Sections 104(a) and 122(e)(6) of CERCLA In the event such a Respondent subsequently changes its decision and desires to acquire authority from U S EPA under Sections 104(a) and 122(e)(6) of CERCLA to undertake the work described in this Order, said Respondent must provide the notice described in this paragraph 99 to U S EPA and receive from U S EPA written permission and authority to proceed with work under this Order

XXVI PENALTIES

100 Each Respondent shall be subject to civil penalties under Section 106(b) of CERCLA 42 U S C § 9606(b), of not more than $27 500 for each day in which said Respondent violates or fails or refuses to comply with this Order without sufficient cause In addition, failure to properly provide response action under this Order or any portion hereof, may result in liability under Section 107(c)(3) of CERCLA 42 U S C § 9607(c)(3), for punitive damages in an amount at least equal to, and not more than three times the amount of any costs incurred by the Fund as a result of such failure to take proper action

XXVII. OPPORTUNITY TO COMMENT AND CONFER

101. On or before the effective date of this Order, each Respondent may submit written comments to U.S. EPA. Respondents asserting a "sufficient cause" defense under Section 106(b) of CERCLA shall describe the nature of the any "sufficient cause" defense using facts that exist on or prior to the effective date of this Order. The absence of a response by U.S. EPA shall not be deemed to be acceptance of Respondent's assertions.

102. Within ten (10) days after the date of issuance of this Order, Respondents may request a conference with the U.S. EPA to discuss this Order. If requested, the conference shall occur with 20 (twenty) days of the date of issuance of this Order, at the office of U.S. EPA, Region 5, in Chicago, Illinois.

103. The purpose and scope of the conference shall be limited to issues involving the implementation of the response actions required by this Order and the extent to which Respondents intends to comply with this Order. This conference is not an evidentiary hearing and does not constitute a proceeding to challenge this Order. It does not give Respondents a right to seek review of this Order or to seek resolution of potential liability. No record of the conference (e.g. stenographic, tape or other physical record) will be made. At any conference held pursuant to Respondent's request, Respondents may appear in person or by an attorney or other representative. Requests for a conference must be by telephone followed by written confirmation to U.S. EPA's RPM.

ADMINISTRATIVE ORDER FOR SAUGET AREA 2 GROUNDWATER INTERIM ACTION, Docket No.

So Ordered, this 30th day of September, 2002.

BY: Wm. E. Muno

William E. Muno, Director
Superfund Division
U.S. Environmental Protection Agency, Region 5

ATTACHMENT 1

Note: inclusion on or exclusion from the list does not constitute a final determination by the Agency concerning the liability of any party for remediation of OU site conditions or payment of past costs.

A-1 Oil Corporation
Aalco Wrecking & Supply Co.
Abco Trash Service & Equipment Company
Alton & Southern Railroad
Phelps Dodge Corporation (formerly known as or successor to Cyprus Amax Minerals Co., Amax Zinc)
American Zinc Company (also known as or predecessor to American Zinc, Lead and Smelting Co.; Gold Fields America Corp; Blue Tee Corp.)
Barry Weinmiller Steel Fabrication
Bi-State Transit Co.
Bi-State Parks Airport
Bi-State Development Agency
Bliss Waste Oil Inc.
Blue Tee Corp.
Browning Ferris Industries of North America – successor to:
C&E Hauling
Cahokia Trust Properties
Cargill Inc.
Century Electric
Century Foundry
Cerro Copper Products Company
Chemical Waste Management Inc.
Clayton Chemical Limited Liability Corp.
Con-Agra, Inc.
Corkery Fuel Company
Crown Cork & Seal Co. Inc.
David Hauling
Dennis Chemical Co. Inc.
Disposal Services Co.
Dotson Disposal "All" Service
Dow Chemical
Eagle Marine Industries, Inc. (formerly known as Notre Dame Fleeting and Towing Inc., and which merged with Riverport Terminal and Fleeting Inc.)
Edgemont Construction
Edwin Cooper Inc.
Eight & Trendy Metal Company
Evans Brothers
Emerald Environmental Group LLC (formerly known as Clayton Chemical)
Ethyl Corporation (formerly known as Edwin Cooper Corporation)
Ethyl Petroleum Additives, Inc.

ExxonMobil Corp. (formerly known as Mobil)
Fruin-Colnon Corporation
The Glidden Co. (formerly known as U.S. Paint)
Gold Fields American Corporation
Hilltop Hauling
Huffmeier Brothers
Illinois Department of Transportation
Industrial Salvage & Disposal Company
Inmont Corporation
Kerr McGee (formerly known as T.J. Moss and Moss American)
Lead and Smelting Company
Mallinckrodt Chemical
Manor Chemical
Midwest Rubber Reclaiming, Division of Empire Chem. Inc.
Mobil Oil Corporation
Monsanto Chemical Company
Olin Corporation
Onyx Environmental Services
Pharmacia Corporation (formerly known as Monsanto Co.)
National Vendors
Northfolk Southern Corporation
Notre Dame Fleeting and Towing Services
Patgood, Inc.
Peavey Company
Phillips Pipe Line Company
Pillsbury Company
River Port Terminal and Fleeting Company
Rogers Cartage
Russell Bliss
Sauget & Co.
Sauget Sanitary Development and Research Assn.
Paul Sauget
Solutia Inc.
St. Louis Grain Co.
Union Electric d/b/a Ameren UE
U.S. Paint Corporation
Village of Cahokia
Village of Sauget
Wiese Planning and Engineering

ATTACHMENT 2

RECORD OF DECISION

SAUGET AREA 2 - GROUNDWATER INTERIM ACTION

Record of Decision

for the

Groundwater Operable Unit (OU-2)

Sauget Area 2 Superfund Site
Sauget, Illinois

September 2002

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

PART I: THE DECLARATION OF THE RECORD OF DECISION

SITE NAME AND LOCATION

The Sauget Area 2 Site (Site) covers approximately 312 acres and is located within the corporate boundaries of Cahokia, East St. Louis, and Sauget, Illinois, in the flood plain bordering the eastern edge of the Mississippi River. The Site is east of the Mississippi River and south of the MacArthur bridge railroad tracks (Figure 1-1). The Site is west of Route 3 (Mississippi Avenue) and north of Cargill Road. The Sauget Area 2 Site consists of five inactive disposal sites: Site O, Site P, Site Q, Site R and Site S.

The United States Environmental Protection Agency (EPA) identification number for Sauget Area 2 is ILD000605790.

STATEMENT OF BASIS AND PURPOSE

This Record of Decision (ROD) presents the selected interim groundwater remedy for the Sauget Area 2 site. This ROD has been developed in accordance with the requirements of the Comprehensive Environmental, Response, Compensation, and Liability Act (CERCLA) of 1980, 42 U.S.C. § 9601 *et seq.* as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practicable, the National Oil and Hazardous Substance Pollution Contingency Plan (NCP), 40 CFR Part 300. This decision selecting the interim groundwater remedy (Response Action) is based on the Administrative Record for the Sauget Area 2 Site. The Administrative Record Index (Appendix B to the ROD) identifies each of the items comprising the Administrative Record upon which the selection of the remedial action is based.

The State of Illinois has indicated its intention to concur with the Selected Remedy. The Letter of Concurrence will be added to the Administrative Record upon receipt.

ASSESSMENT OF THE SITE

The response action selected in this ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment. Such releases or threat of releases may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDY

This interim remedial action for the Groundwater Operable Unit (OU-2) addresses the release of contaminated groundwater into the Mississippi River at the Sauget Area 2 site in the vicinity of disposal Site R. The selected remedy includes the installation of a 3,500 foot long, "U"-shaped, fully penetrating, jet grout barrier wall to be installed between the downgradient boundary of Sauget Area 2 Site R and the Mississippi River (See Figure 9-1) to abate the release of impacted groundwater. Three partially penetrating groundwater recovery wells will be installed inside the "U"-shaped barrier wall to control groundwater moving to the wall. Groundwater quality, groundwater level, sediment and surface water monitoring will be used to ensure acceptable performance of the interim groundwater remedy. Extracted groundwater will be treated and ultimately released to the Mississippi River in compliance with all applicable or relevant and appropriate requirements (ARARs).

Final groundwater and source area remedial actions will be addressed under the site-wide Operable Unit (OU-1) for the Sauget Area 2 Site upon completion of the Sauget Area 2 Remedial Investigation/Feasibility Study (RI/FS) in 2004.

STATUTORY DETERMINATIONS

This interim action is protective of human health and the environment in the short term and is intended to provide adequate protection until a final ROD for Sauget Area 2 is signed; complies with (or waives) those Federal and State requirements that are applicable or relevant and appropriate (ARARs) for this limited-scope action; and is cost-effective. Although this interim action is not intended to address fully the statutory mandate for permanence and treatment to the maximum extent practicable, this interim action does utilize treatment and thus is consistent with the statutory mandate. Because this action does not constitute the final remedy for the Sauget Area 2 Groundwater Operable Unit, the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element, although partially addressed in this remedy, will be addressed by the final response action. A final response action to fully address the threats posed by conditions at the Sauget Area 2 Site will be taken upon completion of the Sauget Area 2 Remedial Investigation/Feasibility Study (RI/FS) in 2004. Operation of the physical barrier and groundwater extraction system will provide additional information to be used in developing options for a final long-term comprehensive groundwater remedy. Because this remedy will result in hazardous substances remaining on-site above health-based levels, a review will be conducted to ensure that the remedy continues to provide adequate protection. Because this is an interim action ROD, review of this site and remedy will be ongoing as EPA continues to develop remedial alternatives for the Sauget Area 2 Site.

ROD DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary section of this ROD. Additional information can be found in the Administrative Record for this site.

- Chemicals of concern (COCs) and their respective concentrations (See Sections 7.1.1 and 7.2.3).
- Baseline risk represented by the COCs (See Sections 7.1 and 7.2).
- Cleanup levels established for COCs and the basis for the levels (See Section 11.4).
- Whether source materials constituting principal threats are found at the Site (See Section 4).
- Current and future land and groundwater use assumptions used in the baseline risk assessment and ROD (See Section 6).
- Potential land and groundwater use that will be available at the site as a result of the Selected Remedy (See Sections 6 and 11.4).
- Estimated capital, annual operation and maintenance (O&M), and total present worth costs; discount rate; and the number of years over which the remedy cost estimates are projected (See Section 11.3).
- Key factor(s) that led to selecting the remedy (See Section 10 - Comparative Analysis of Alternatives).

PART II: DECISION SUMMARY

1. SITE NAME, LOCATION, AND BRIEF DESCRIPTION

The Sauget Area 2 Site covers approximately 312 acres and is located within the corporate boundaries of Cahokia, East St. Loui.·. and Sauget, Illinois, in the flood plain bordering the eastern edge of the Mississippi River. The Sauget Area 2 Site is east of the Mississippi River, south of the MacArthur bridge railroad tracks, west of Route 3 (Mississippi Avenue) and north of Cargill Road (Figure 1-1). The Sauget Area 2 Site consist of five inactive disposal sites:

Site	**Former Use**	**Municipality**
Site O	Sewage Sludge Dewatering	Village of Sauget
Site P	Municipal and Industrial Waste Disposal	City of East St. Louis and Village of Sauget
Site Q	Municipal and Industrial Waste Disposal	Village of Sauget and Village of Cahokia
Site R	Industrial Waste Disposal	Village of Sauget
Site S	Chemical Reprocessing Waste Disposal	Village of Sauget

The above sites are located in an area historically used for heavy industry, including chemical manufacturing, metal refining, petroleum refining, and power generation and waste disposal. Currently the area is used for heavy industry, warehousing, bulk storage (coal, refined petroleum, lawn and garden products and grain), wastewater treatment, hazardous waste treatment, waste recycling and truck terminals. Four commercial establishments are located at the north end of the Site. No residences are located within the Site. Residential areas closest to Sauget Area 2 are approximately 3,000 feet east of Site P and about 3,000 feet east of Site O. These residential areas are located, respectively, in East St. Louis and Cahokia. The source of drinking water for area residents is an intake in the Mississippi River located approximately 3 miles upstream of the Site.

EPA is the lead agency for this Site and the Illinois Environmental Protection Agency (IEPA) is the support agency involved.

AUTHORIZING SIGNATURE

Wm. E. Muno

William E. Muno, Director
Superfund Division
U.S. Environmental Protection Agency

9/30/02
Date

2. SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.1 SITE OPERATING HISTORY

Sauget Area 2 consists of five inactive disposal sites: Site O, Site P, Site Q, Site R and Site S. The history of each of these disposal sites is described below.

Site O - Site O, located on Mobile Avenue in Sauget, Illinois, occupies approximately 20 acres of land to the northeast of the American Bottoms Regional Treatment Facility (ABRTF). An access road to the ABRTF runs through the middle of the site. In 1952, the Village of Sauget Waste Water Treatment Plant began operation at this location. In addition to providing treatment for the Village of Sauget, the plant treated effluent from the various Sauget industries. Site O consists of four closed lagoons constructed in 1965 at the Village of Sauget Wastewater Treatment Plant and placed in operation in 1966/1967. Between 1966/67 and approximately 1978, these lagoons were used to dispose of clarifier sludge from the wastewater treatment plant. In 1980, the Village of Sauget closed four clarifier sludge lagoons at Site O by stabilizing the sludge with lime and covering it with approximately two feet of clean, low-permeability soil. Currently, the lagoons are vegetated.

Site P - Site P, which is bounded by the Illinois Central Gulf Railroad tracks, the Terminal Railroad Association tracks and Monsanto Avenue, occupies approximately 20 acres of land located in the City of East St. Louis and the Village of Sauget. Operated by Sauget and Company from 1973 to approximately 1984, Site P was an IEPA-permitted landfill, accepting general wastes, including diatomaceous-earth filter cake from Edwin Cooper and non-chemical wastes from Monsanto.

Site Q - Site Q, a former subsurface and surface disposal area, occupies approximately 90 acres in the Villages of Sauget and Cahokia. This Site is divided by the Alton and Southern Railroad into a northern portion and a southern portion. The northern portion consists of approximately 65 acres bordered on the north by Site R and Monsanto Avenue. The northern portion is bordered on the south by the main track of the Alton and Southern Railroad and property owned by Patgood Inc. On the east, the northern portion of the site is bordered by the Illinois Gulf Central Railroad and the US Army Corps of Engineers (USACE) flood control levee and on the west the Site is bordered by the Mississippi River. The northern portion of Site Q that wraps around the eastern boundary of Site R is known as the "dogleg" portion of Site Q.

The southern portion consists of approximately 25 acres, north of Cargill Road and south of the Alton and Southern Railroad. The southern portion is bounded on the west by a 10-ft wide easement owned by Union Electric for transmission lines and a spur track of the Alton and Southern Railroad to the Fox Terminal. A barge terminal operated by St. Louis Grain Company is located between the Union Electric easement, the spur track and the Mississippi River. Southern Site Q is bordered on the east by the Illinois Central Gulf Railroad and the flood control levee.

Disposal started at Site Q in the 1950s and continued until the 1970s. Allegedly, Sauget and Company started operation of a landfill south of the River Terminal in 1966 and terminated operations in 1973. This facility took various wastes including municipal waste, septic tank pumpings, drums, organic and inorganic wastes, solvents, pesticides and paint sludges. It also took plant trash from Monsanto, waste from other industrial facilities and demolition debris.

Site R - Site R, a closed industrial-waste disposal area owned by Solutia Inc, is located between the flood control levee and the Mississippi River in Sauget, Illinois. Its northern border is Monsanto Avenue and its southern border is Site Q. This site is now known as the "River's Edge Landfill". The former landfill occupies approximately 22 acres of the 36-acre site. A portion of Site Q, known as the "Dog Leg", is located to the east of Site R.

Industrial Salvage and Disposal, Inc. (ISD) operated the River's Edge Landfill for Monsanto from 1957 to 1977. Hazardous and non-hazardous bulk liquid and solid chemical wastes and drummed chemical wastes from Monsanto's W.G. Krummrich plant and, to a lesser degree, it's Queeny plant in St. Louis were disposed at Site R. Disposal began in the northern portion of the site and expanded southward. Wastes contained phenols, aromatic nitro compounds, aromatic amines, aromatic nitro amines, chlorinated aromatic hydrocarbons, aromatic and aliphatic carboxylic acids and condensation products of these compounds. Pursuant to a negotiated agreement with the State of Illinois, Monsanto installed a two to eight foot thick, clay cover on Site R in 1979 to cover the waste, limit infiltration through the landfill and prevent direct contact with the landfill material. In 1985, Monsanto installed a 2,250 foot long rock revetment along the bank of the Mississippi River downgradient of Site R to prevent erosion of the riverbank and minimize the potential for the release of waste material from the landfill.

Site S - Site S, located southwest of Site O, is a small disposal site less than one acre is size. Based on available information, the property is or was owned by the Village of Sauget, Clayton Chemical and the Resource Recovery Group. In the mid-1960s, solvent recovery began on the Clayton Chemical property, which is now owned by the Resource Recovery Group (RRG). The waste solvents were steam-stripped resulting in still bottoms that were allegedly disposed of in a shallow, on-site excavation that is now designated Site S. Historical aerial photographs indicate that Site S was potentially a waste and/or drum disposal area.

2.2 ACTIONS TO DATE

2.2.1 Site O

In 1980, the Village of Sauget closed four clarifier sludge lagoons at Site O by stabilizing the sludge with lime and covering it with approximately two feet of clean, low-permeability soil. Currently, the lagoons are vegetated.

2.2.2 Site R

In 1979, Monsanto completed the installation of a clay cover on Site R to cover waste, limit infiltration through the landfill, and prevent direct contact with fill material. The cover's thickness ranges from 2 feet to approximately 8 feet. In 1985, Monsanto installed a 2,250-foot long rock revetment along the east bank of the Mississippi River adjacent to Site R. The purpose of the stabilization project was to prevent further erosion of the riverbank and thereby minimize potential for the release of waste material from the landfill. During the 1993 flood, Site R was flooded but the clay cap was not overtopped. No erosion of the riverbank or cap resulted from this flood.

On February 13, 1992, the State of Illinois and Monsanto signed a consent decree entered in St. Clair County Circuit Court requiring further remedial investigations and feasibility studies to be conducted by Monsanto on Site R. The results of the Remedial Investigation/Feasibility Study were submitted to IEPA in 1994.

2.2.3 Site Q

In 1993, during the highest recorded flood in St. Louis' history, Site Q was flooded and river currents unearthed a number of barrels containing hazardous waste. EPA conducted a CERCLA removal action at the northern portion of Site Q in 1995 to stabilize the area scoured by the flood waters.

EPA initiated a second removal action at disposal Site Q on October 18, 1999. The EPA contractor began to excavate site wastes on October 26, 1999 from eight excavation areas of various sizes on approximately 25-acres at the southern end of disposal Site Q. Two waste streams were developed based upon analytical results of the separate waste piles: 1) a low-level PCB waste stream with soil concentrations less than 50 ppm) that was shipped via truck to the Milam Recycling and Disposal Facility located in East St. Louis, Illinois and 2) a PCB waste stream with soil/debris containing greatet than 50 ppm PCBs that was shipped via rail car to the Safety-Kleen Lone & Grassy Mountain facility, located in Waynoka, Oklahoma. One hundred sixty three trucks, each containing approximately 20 tons of low-level PCB waste, were shipped to the Milam disposal facility. One hundred forty one rail cars, each containing approximately 90 tons of PCB waste, were shipped to the Lone Mountain facility. Drums excavated on site were crushed and added to either waste stream. Excavated drums that were void of waste material were added to either PCB waste stream; drums that contained waste were added to the greater than 50 ppm PCB waste stream. On April 5, 2000, removal of site wastes was completed. Approximately 17,032 tons of waste and 3,271 drums were removed from the site. Due to limited resources and the amount of contamination, this removal action did not address all of the contaminants present on disposal Site Q.

2.3 INVESTIGATION HISTORY

Numerous investigations have been conducted at or near the Sauget Area 2 Site prior to the initiation of the Remedial Investigation/Feasibility Study (RI/FS) by a Sauget Area 2 Potentially Responsible Party (PRP) group in 2002.

In 1998, Ecology and Environment (E&E) prepared on behalf of EPA Region 5 the report "Sauget Area 2 Data Tables/Maps for EPA, Region 5". This report summarized existing data for each site along with other information compiled by E&E during its file searches of various agencies and organizations. It contains data from investigations conducted by Clayton Environmental Consultants, Dynamac, E&E, IEPA, Geraghty and Miller, Reidel Industrial Waste Management, Russell and Axon and EPA.

On February 13, 1992, the State of Illinois and Monsanto signed a consent decree entered in St. Clair County Circuit Court requiring further remedial investigations and feasibility studies to be conducted by Monsanto on Site R. The results of the RI/FS were submitted to IEPA in 1994.

A Resource Conservation and Recovery Act (RCRA) Administrative Order on Consent (AOC) signed by Solutia and EPA requires Solutia to complete activities necessary to identify and define the nature and extent of releases of hazardous waste and/or hazardous constituents at or from the W.G. Krummrich Facility. This May 3, 2000, AOC also requires Solutia to prepare a Description of Current Conditions Report, a Groundwater Environmental Indicators Report (EIR) and a Current Human Exposure Environmental Indicators Report. In January and May 2000, Solutia collected groundwater samples from selected existing monitoring wells to determine the areal and vertical distribution of volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) in groundwater between its W.G. Krummrich plant and the Mississippi River. Surface water, sediment and fish sampling conducted in the Mississippi River in October and November 2000, demonstrated that groundwater releasing to surface water in the vicinity of Sauget Area 2 disposal Site R is adversely impacting the Mississippi River.

In October and November 2000, EPA collected sediment samples in the Mississippi River in and adjacent to area of suspected groundwater release from Solutia's W.G. Krummrich plant. This work was performed in conjunction with Solutia's implementation of its Surface Water Sampling Plan using the same methods and sampling personnel, methods and equipment.

2.4 ENFORCEMENT HISTORY

On February 13, 1992, the State of Illinois and Monsanto signed a consent decree entered in St. Clair County Circuit Court requiring remedial investigations and feasibility studies to be conducted by Monsanto on Site R. The results of the Remedial Investigation/Feasibility Study were submitted to Illinois EPA in 1994.

On May 3, 2000, EPA and Solutia entered into a RCRA AOC which requires Solutia to complete activities necessary to identify and define the nature and extent of releases of hazardous waste and/or hazardous constituents at or from the W.G. Krummrich Facility. The AOC also requires Solutia to propose, by June 1, 2004, final corrective measures necessary to protect human health and the environment for all current and future unacceptable risks due to releases of hazardous waste or hazardous constituents at or from the facility.

On November 24, 2000, an AOC for the Sauget Area 2 Site, was entered into by EPA and a group of PRPs. The AOC requires the Sauget Area 2 Sites Group to conduct a Remedial Investigation (RI) and to prepare a Feasibility Study (FS). RI sampling activities were initiated in 2002 and will be concluded in November 2002.

On September 13, 2001, EPA proposed adding the Sauget Area 2 Site to the National Priorities List (NPL) of Superfund sites. EPA is the lead regulatory agency for the Sauget Area 2 Site and the IEPA is the support agency.

On November 14, 2001, EPA sent a request to the Sauget Area 2 Sites Group to prepare a focused feasibility study (FFS) for the Groundwater Operable Unit (OU-2) to address the known groundwater contamination problem in the vicinity of Site R. The request was made based on information collected by Solutia and EPA in 2000 and 2001. Solutia prepared an FFS independent of the Sauget Area 2 Sites Group.

3. COMMUNITY PARTICIPATION

This section summarizes the community relations activities by EPA during the remedy selection process. EPA developed a Community Relations Plan (CRP) for the site dated August 25, 2000. The CRP was designed to promote public awareness of cleanup activities and investigations and to promote public involvement in the decision-making process. Community participation activities have included personal interviews, fact sheets, and newspaper notices.

The FFS and Proposed Plan for the Sauget Area 2 Groundwater Interim Action were made available to the public in June 2002. These documents, along with others that form the basis for the cleanup decisions for the site, can be found in the Administrative Record File located at the EPA Region 5 Records Center at 77 West Jackson Blvd., Chicago, Illinois and the

Cahokia Public Library District, 140 Cahokia Park Drive, Cahokia, Illinois. Notice of the availability of these two documents was published in the Beleville News Democrat, on June 17, 2002. On June 17, 2002, a fact sheet and a copy of the Proposed Plan were mailed to all individuals on the Sauget Area 2 Site mail list. A public comment period was held from June 17, 2002, to July 17, 2002. An extension to the public comment period was requested. As a result, it was extended to August 16, 2002. A public meeting was held on June 24, 2002, to present the Proposed Plan. Approximately 25 people attended the meeting. EPA's response to comments received during this period is included in the Responsiveness Summary, which is part of this Record of Decision (ROD).

4. SCOPE AND ROLE OF RESPONSE ACTION

This interim groundwater remedial action, referred to as Operable Unit 2 (OU-2), is intended to address the adverse impacts from the known groundwater contamination problem in the vicinity of Site R. Based on the currently available groundwater and sediment information, it is apparent that groundwater, with contaminant concentrations above acceptable levels, is being released to the Mississippi River in the vicinity of disposal Site R. An ecological risk assessment performed in June 2001 indicates there is an adverse impact on the Mississippi River resulting from this release. EPA has determined that an interim action is necessary to restrict the migration of the groundwater contamination and mitigate an unacceptable release of contaminated groundwater to surface water in the vicinity of disposal Site R. A final remedy for the Sauget Area 2 Site will be selected upon completion of the RI/FS.

With respect to the source areas and principal threats for OU-2, they are not within the scope of this interim groundwater remedial action. The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by a site wherever practical. A principal threat concept is applied to the characterization of "source material" at a Superfund site. A source material is material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contaminant to groundwater, surface water or air, or acts as a source for direct exposure. EPA has defined a principal threat wastes as those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur. The OU-2 source areas likely contain principal threat wastes including dense nonaqueous phase liquids (DNAPLs). The source areas and principal threats will be addressed as part of the final response action for the Sauget Area 2 Site upon completion of the Sauget Area 2 RI/FS in 2004.

5. SITE CHARACTERISTICS

This section summarizes currently available information for the site. The major characteristics of the site and the nature and extent of contamination are summarized below. More detailed information is contained in the FFS, which is contained in the Administrative Record for the Site. See Section 3 for further information on the Administrative Record.

5.1 CONCEPTUAL SITE MODEL

The Conceptual Site Model (CSM) for Human Health is depicted in Figure 5-1, and for Ecological in Figures 5-2 through 5-4. The CSM identifies potential sources, potential environmental release mechanisms, potential exposure pathways, potential exposure routes, and potential human and ecological receptors. The CSM will be reviewed and modified, as necessary, once the analytical data from the Area 2 RI become available.

Based on all currently available information and for the purpose of this CSM, the sources of contamination in environmental media are various source areas upgradient from the area of impact adjacent to disposal Site R. Disposal areas contributing to the groundwater contamination problem include, but are not limited to, Sauget Area 2 disposal sites O, Q, and R, Sauget Area 1 Site I, the W.G. Krummrich Plant, and the Clayton Chemical Facility. Constituents in the sites have released to soils and from there leached to underlying groundwater. The aquifer beneath the Sauget Area 2 Site consists of three distinct hydrogeologic units: 1) the Shallow Hydrogeologic Unit (SHU) with fine-grained, silty sands, 2) the Middle Hydrogeologic Unit (MHU) with clean, medium to course sand, and 3) the Deep Hydrologic Unit (DHU) with clean, medium to course sand and gravel. The ultimate point of release for these units is the Mississippi River. Leachate migrating from the waste disposal areas enters into these hydrogeologic units and then is released to the river via groundwater. Constituents that are released through groundwater will first pass through the sediments of the river channel prior to entering the water column. Site receptors including outdoor industrial workers, construction/utility workers, and trespassers may come into contact with contaminated soils, ingest soils, inhale VOCs from soils and groundwater. Trespassers and recreational fisherman may come into contact with or ingest surface water or sediment; and the recreational fisherman may consume organisms that have accumulated contamination.

5.2 PHYSICAL CHARACTERISTICS OF THE SITE

5.2.1 Surface Features

Sauget Area 2 is situated in a floodplain of the Mississippi River called the American Bottoms. It is located on the eastern side of the river directly opposite St. Louis, Missouri (Figure 1-1). As a whole, the floodplain encompasses 175 square miles, is 30 miles long, and has a maximum width of 11 miles. It is bordered on the west by the Mississippi River and on the east by bluffs that rise 150 to 200 feet above the valley bottom. The floodplain is relatively flat and generally slopes from north to south and from east to west. Land surface lies between 400 and 445 feet above mean sea level (MSL).

Locally, the topography consists of nearly flat bottomland with slight irregularities. Elevations across the study area range from 400 to 430 feet MSL and the land surface trends in a southeastward/northwestward direction. Land surface elevations are highest adjacent to the Mississippi River (EL 430 ft MSL) and decrease to EL 400 to 410 ft MSL approximately 1,000 to 1,500 feet east of the river.

5.2.2 Climate

The National Climatic Data Center (NCDC) describes the areas' climate as modified continental, subject to four-season climate changes without the undue hardship of prolonged periods of extreme heat or high humidity. To the south is the warm, moist air of the Gulf of Mexico; and to the north, in Canada, is a region of cold air masses. The convergence of air masses from these sources, and the conflict on the frontal zones where they come together, produce a variety of weather conditions, none of which are likely to persist for any great length of time.

Winters are brisk and seldom severe. Records since 1870 show that the temperature drops to zero degrees Fahrenheit (0°F) or below on average two to three days per year. The area stays at or below 32°F for less than 25 days in most years. Average snowfall for the area is a little over 18 inches per winter season. Snowfall of an inch or more is received on five to ten days in most years. The long-term record for the St. Louis area (since 1870) indicates that temperatures of 90°F or higher occur on about 35 to 40 days per year, and extremely hot days of 100°F or more are expected no more than five days per year.

The normal annual precipitation for the area is slightly less than 34 inches. The winter months are the driest, with an average total of about six (6) inches of precipitation. The spring months of March through May are normally the wettest with normal precipitation of just under 10.5 inches.

5.2.3 Geology

The American Bottoms are underlain by unconsolidated valley fill composed of recent alluvium, known as the Cahokia Alluvium, which overlies a unit of glacial material known as the Henry Formation. The Cahokia Alluvium is approximately 40 feet thick and consists of unconsolidated, poorly-sorted, fine-grained material with some local sand and clay lenses. These alluvial deposits unconformably overlie the Henry Formation, which is composed of medium to coarse sand and gravel that increases in grain size with depth. This unit is approximately 95 feet thick and generally becomes thinner with increasing distance from the Mississippi River.

The valley fill throughout the floodplain is underlain by a bedrock system of Mississippian and Pennsylvanian age. The bedrock consists primarily of limestone and dolomite with some sandstone and shale, and is older in the central and western sections of the American Bottoms.

Cross sections showing regional geology are provided as Figures 5-5 and 5-6.

Two types of water-bearing formations exist in the American Bottoms: unconsolidated and consolidated. The unconsolidated formations (predominantly silt, sand, and gravel) are those that lie between the ground surface and the bedrock/gravel interface. The thickness of the unconsolidated formation varies throughout the area, but is typically estimated to be approximately 100 feet. Finer-grained sediments generally dominate at the ground surface and become coarser and more permeable with depth, creating semi-confined conditions within the aquifer. Thus, permeability and porosity increase in the unconsolidated formation with depth. The consolidated formations are deep bedrock units of limestone and dolomite that exhibit low permeability and are not considered to be a significant source for groundwater in the area.

As reported in "Groundwater Management in the American Bottoms, Illinois," hydraulic properties of the unconsolidated aquifer have been determined from 10 aquifer tests and 100 specific capacity tests conducted on industrial, municipal, irrigation and relief wells. The coefficient of storage for the aquifer ranged from 0.002 to 0.155. Reported hydraulic conductivity values average 3,000 gallons per day per square foot (gpd/ft^2) which is equivalent to $1.4x10^{-1}$ cm/s.

Recharge to the aquifer occurs through four (4) sources: precipitation, infiltration from the Mississippi River, inflow from the buried valley channel of the Mississippi River, and subsurface flow from the bluffs that border the flood plain on the east.

5.2.4 Hydrology

The Mississippi River, bordering the American Bottoms to the west, is the major surface-water body draining the area. It is fed by a complex network of natural and artificial channels that was extensively improved throughout the 20th Century. According to an investigation of groundwater resources conducted by the Illinois State Water Survey Division, at least 40 miles of improved drainage ditch have been constructed and the natural lake area in the center of the flood plain has been reduced by more than 40 percent.

5.2.5 Hydrogeology

Sauget Area 2 is located in the southwestern section of the American Bottoms flood plain. More specifically, it is situated south of East St. Louis, and extends approximately three-quarters to one mile east of the eastern bank of the Mississippi River. The stratigraphy beneath the site is much like that of the rest of the flood plain. The Cahokia Alluvium is about 30 feet thick and is a fine silty sand that is gray and brown in color. Below this, the unconsolidated deposits of the Henry Formation are present. Locally, the Henry Formation is characterized by medium-to-coarse sand that becomes coarser and more permeable with depth. The thickness of this unit ranges from 140 feet near the river to about 100 feet on the east side of the site. The groundwater level is currently between 10 to 20 feet below ground surface, but fluctuates during times of heavy and light precipitation.

Geologic data show that the unconsolidated deposits range from 140 feet thick near the river to about 100 feet in the eastern part of the study area. At most locations, the contact between Cahokia Alluvium and the Henry Formation cannot be distinguished. However, as previously mentioned, three distinct hydrogeologic units can be identified: 1) a shallow hydrogeologic unit (SHU); 2) a middle hydrogeologic unit (MHU); and 3) a deep hydrogeologic unit (DHU). The 20 feet thick SHU includes the Cahokia Alluvium (recent deposits) and the uppermost portion of the Henry Formation. This unit is primarily an unconsolidated, fine-grained silty sand with low to moderate permeability. The 30 feet thick MHU is formed by the upper to middle, medium to coarse sand portions of the Henry Formation. It contains a higher permeability sand than found in the overlying shallow hydrogeologic unit, and these sands become coarser with depth. At the bottom of the aquifer is the DHU, which includes the high permeability, coarse-grained deposits of the lower Henry Formation. This zone is 40 feet thick. In some areas, till and/or boulder zones were encountered 10 to 15 feet above the bedrock.

During low river stage conditions, groundwater at Sauget Area 2 flows from east to west and releases to the Mississippi River, the natural point of release for groundwater in the American Bottoms aquifer. For example, in October 2001 groundwater elevations in the Middle Hydrogeologic Unit were 394 ft MSL at Route 3 (Mississippi Avenue) and 389 ft. MSL at the downgradient limit of Site R when the average river elevation was 390 ft MSL. When flood stage occurs in the Mississippi River, flow reverses. For example, in November 1985 river stage was 32 to 33 feet above the USACE datum (low flow river stage is 5 to 7 feet above this datum). Groundwater elevation in the MHU at the downgradient edge of Site R was 406 ft. MSL and 394 ft. MSL at Route 3. Under these conditions, groundwater flow was from west to east for a distance of approximately 4,500 feet. Horizontal groundwater gradients beneath Sauget Area 1 average about 0.001 feet per foot (ft/ft) to the west. Downward vertical gradients occur on parts of the site, with varying magnitudes depending on location and season.

Aquifer tests performed over a span of 30 years have established characteristics such as transmissivity, hydraulic conductivity, storage coefficient and groundwater velocity. Tests have been conducted for all three (3) groundwater units and are summarized as follows:

	Transmissivity gpd/ft	Hydraulic Conductivity	Storage Coefficient
Shallow Hydrogeologic Unit	141.5 gpd/ft	9.5 gpd/ft^2 (4 x 10^{-4} cm/s)	**Not Available**
Middle Hydrogeologic Unit	165,000 gpd/ft	3,300 gpd/ft^2 (1.6 x 10^{-1} cm/s)	0.04
Deep Hydrogeologic Unit	211,000 gpd/ft	2,600 gpd/ft^2 (1.2 x 10^{-1} cm/s)	0.002 - 0.100

Note: Results are averages.

Groundwater flow velocity is on the order of 0.02 feet per day (7 feet per year), 4 feet per day (1,500 feet per year) and 6 feet per day (2,200 feet per year), respectively, in the SHU, the MHU and the DHU.

5.3 SUMMARY OF SITE INVESTIGATION ACTIVITIES

5.3.1 Nature and Extent of Contaminants

The remedial investigation for the Sauget Area 2 Site is currently ongoing. However, numerous sampling investigation have previously been conducted in the area. Sediment, groundwater, surface water and soil samples have been collected on and adjacent to the Sauget Area 2 Site, and upgradient of the Site. The nature and extent of sediment, groundwater, surface water, and soil contamination is summarized below and discussed in more detail in the FFS.

5.3.1.1 Surface Water and Sediments

Solutia Surface Water Sampling Plan

An AOC under RCRA requires Solutia to complete activities necessary to identify and define the nature and extent of releases of hazardous waste and/or hazardous constituents at or from the W.G. Krummrich plant. The W.G. Krummrich plant is located upgradient from the groundwater contamination being released to the Mississippi River adjacent to Sauget Area 2 disposal Site R and the resulting impact area. The W.G. Krummrich plant currently produces primarily monochlorobenzene. The plant began operations in Sauget in the early 1900's, and has produced a wide variety of products in the past including: adipic acid, alkylbenzene, aroclors, benzyl chloride, calcium benzene sulfonate, caustic soda, chlorine, chlorinated cyanuric acid, chlorobenzenes, chlorophenols, 2,4-D, fatty acid chloride, monochloroacetic acid, muriatic acid, nitric acid, nitric cake, nitroaniline, nitrodiphenylamine, nitrophenol, phenol, phosphoric acid, phosphorus halides, potash, potassium phenyl acetate, salt cake, Santicizer-160, Santoflex, Santolube 393, Santomerse #1, sulfuric acid, 2,4,5-T, tricresyl phosphate and zinc chloride.

Elevated levels of VOCs and SVOCs are located in groundwater at the plant. The following have been found in concentrations higher than the IEPA Tiered Approach to Cleanup Objectives (TACO) Tier 1 Industrial Criteria, are listed below:

VOCs	SVOCs	
Benzene	Chloroaniline	Nitrobiphenyl
Chlorobenzene	Chlorophenol	Nitrophenol
1,2-Dichloroethene	Dichlorobenzene	Pentachlorophenol
Ethylbenzene	Dichlorophenol	Phenol
Methyl Isobutyl Ketone	Naphthalene	Trichlorobenzene
Methylene Chloride	Nitroaniline	Trichlorophenol
Toluene	Nitrobenzene	
1,1,1-Trichloroethane		
Xylene		
Vinyl Chloride		

Pursuant to the RCRA AOC, Solutia submitted a Description of Current Conditions Report, which included a Site Sampling Plan, to EPA on August 1, 2000. Surface Water, Groundwater and Soil Sampling Plans were included in the Site Sampling Plan. Pursuant to this plan, Solutia conducted surface water, sediment and fish sampling in the Mississippi River in October 2000 to determine the impact, if any, of groundwater migrating from the W.G. Krummrich facility. Solutia collected surface water and sediment samples in the Mississippi River at three locations: 1) upstream of the plume release area, 2) the plume release area and 3) downstream of the plume release area.

Solutia analyzed the samples to determine the concentration of VOCs, SVOCs, Pesticides, Herbicides, PCBs and Dioxin in these environmental media. In addition, benthic community structure was evaluated to provide data for sediment triad evaluation. Bioassays were conducted on surface water and sediment samples to determine the toxicity, if any, of these environmental media to sensitive organisms. Fish were sampled in the plume release area and upstream and downstream of this release to determine the impact, if any, on higher trophic level organisms. Information collected as part of the Surface Water Sampling Plan will be used in an Ecological Risk Assessment, a Human Health Risk Assessment, a Groundwater Environmental Indicators Report and a Current Human Exposure Environmental Indicators Report.

Reconnaissance Survey - Solutia conducted a reconnaissance survey in September 2000 to characterize river bottom substrates and identify surface water, sediment and fish sampling locations. During this reconnaissance survey, conducted in conjunction with EPA, sediment samples were collected in the area where groundwater plume is being released to surface water along three transects running from the bank towards the center of the river. Analytical results are summarized below:

	Distance from Bank, feet								
Total VOCs, ppb	**50**	**200**	**300**	**400**	**500**	**600**	**700**	**1000**	**1400**
North Transect	644	NS	854	ND	NS	NS	ND	ND	ND
Center Transect	1300	ND	NS	NS	ND	NS	NS	NS	NS
South Transect	45	NS	473	NS	NS	1	NS	NS	NS

River Sampling - Solutia's sediment sample analyses indicated that sampling transects located 300 ft from the riverbank would be within the area of plume release. Therefore, surface water samples were collected along three transects running parallel to the bank and located 50, 150 and 300 ft from the riverbank. Three sampling stations were located on each transect resulting in nine sampling stations within the plume release area. One sampling station was located at the center point of each transect. Another sampling station was located half way between the center station and the upstream end of each transect. A third sampling station was located half way between the center station and the downstream end of each transect.

At each sampling station, Solutia collected one surface water sample and analyzed the sample for VOCs, SVOCs, Pesticides, Herbicides, PCBs and Dioxin to determine the concentration of these constituents in surface water. Samples were collected just above the sediment/surface water interface. Bioassays, using Cerodaphnia and Fat Head Minnows, were performed on each surface water sample to determine surface water toxicity. In addition, one sediment sample was collected at each sampling station and analyzed for VOCs, SVOCs, Pesticides, Herbicides, PCBs and Dioxin to determine the concentration of these constituents in sediments. Bioassays, were performed on each sediment sample to determine sediment toxicity. Benthic community structure was determined using three grab samples collected at selected locations within each sampling area.

One local area of soft bottom sediment was observed during the September 2000 reconnaissance survey at a wing wall downstream of the site. One soft bottom sample was collected in this area and analyzed for VOCs, SVOCs, Pesticides, Herbicides, PCBs and Dioxin. Bioassays were performed on this sediment sample to determine sediment toxicity. Three grab samples were collected at this sampling station to determine benthic community structure. One surface water sample was collected at this location and analyzed for VOCs, SVOCs, Pesticides, Herbicides, PCBs and Dioxin. Bioassays were performed on this surface water sample to determine surface water toxicity. To provide a basis for comparison, one soft bottom sample station was selected upstream of the site and similar evaluations as described above conducted at this station.

Sediment, surface water and fish tissue analytical result summaries and a summary of sediment and surface water toxicity testing are included in Tables 5-1, 5-2, 5-3, 5-4, 5-5 and 5-6. Sampling locations are shown on Figures 5-7, 5-8, 5-9 and 5-10. These analytical data were used to prepare the Ecological Risk Assessment summarized in Section 7.2.3.

EPA Sediment Sampling

In October and November 2000, EPA collected sediment samples in the Mississippi River in and adjacent to the area where groundwater from Solutia's W.G. Krummrich plant (Figures 5-11 and 5-12) is being released to the Mississippi River. This work was performed in conjunction with Solutia's implementation of its Surface Water Sampling Plan using the same methods and sampling personnel, methods and equipment. EPA's analytical data summaries are included in Table 5-7.

EPA data shows that sediment is contaminated with significant concentrations of VOCs and SVOCs starting at the northern edge of disposal Site R. This area is also the approximate northern boundary of a groundwater contaminant plume at disposal Site R that is being released to the Mississippi River. Significant concentrations of VOCs and SVOCs in sediment continue along and south of disposal Site R, the approximate southern boundary of the groundwater contaminant plume. Significant concentrations of pesticides, a herbicide, and polychlorinated biphenyls (PCBs) were also found near the middle and southern boundary of Site R, in the approximate center of the groundwater contaminant plume.

5.3.1.2 Groundwater

Solutia Groundwater Sampling

In January and May 2000, pursuant to the requirements found in the RCRA AOC, Solutia collected groundwater samples from selected existing monitoring wells to determine the areal and vertical distribution of VOCs and SVOCs in groundwater between its W.G. Krummrich plant and the Mississippi River. Solutia groundwater data correlates well with both the type and extent of contamination found in Mississippi River sediment indicating that contaminated groundwater in OU1 is a primary contributor to contamination of Mississippi River sediments. Groundwater data from May 2000 for wells monitoring the MHU and DHU near the northern extent of sediment contamination (wells GM-27B and GM-27C) found up to 1,400 parts per billion (ppb) of benzene, 11,000 ppb of chlorobenzene, 700 ppb of toluene, 39,000 ppb of aniline, 8,100 ppb of phenol, 300 ppb of 4-chlorophenol, 20,000 ppb of 2-chloroaniline, 25,000 ppb of 3-chloroaniline, and 25,000 ppb of 4-chloroaniline.

Total VOC and Total SVOC concentrations were plotted and contoured for the SHU, MHU and DHU and the results are presented in Figures 5-13 through 5-18. Based on these isoconcentration plots, VOCs and SVOCs are present in groundwater from the Mississippi River to the W.G. Krummrich plant. Two concentration highs are evident on these figures at the Sauget Area 2 Sites R and Q (Dog Leg) immediately adjacent to the Mississippi River and at the W.G. Krummrich plant. To a lesser extent, Figure 5-16 (SHU-SVOCs) also shows a concentration high at Site O. Total VOC concentration highs in the SHU, MHU and DHU are located in the northern half, northern two thirds and the extreme northern end of Site R, respectively, while the Total SVOC concentration highs are located in the central portions of Site R for all three of these hydrogeologic units. Estimated mass loading to the Mississippi River in the vicinity of Site R is 220,000 kg/yr (484,000 pounds per year) or 603 kg/day (1,327 pounds per day).

These January and May 2000 groundwater data indicate there is a distinct vertical stratification of Total VOC and Total SVOC concentrations at Site R with concentrations decreasing with depth:

	Total VOC Concentration (ppb)	Total SVOC Concentration (ppb)
Shallow Hydrogeologic Unit	74,600	6,760,000
Middle Hydrogeologic Unit	47,210	1,529,000
Deep Hydrogeologic Unit	1,950	34,800

This distinct vertical concentration gradient, with the highest detected concentrations in the upper portions of the saturated zone, indicates that the waste material and/or DNAPL in the SHU is still acting as a source that impacts groundwater quality. Total SVOC concentrations of 6,760,000 in the SHU and 1,529,000 in the MHU indicate that DNAPL is probably present in the aquifer. Dissolution of DNAPL coating the aquifer matrix or trapped in aquifer pore spaces will act as a long-term, continuous source of impacted groundwater.

Solutia collected groundwater data during pre-design investigations performed in July 2001 to obtain design information for a groundwater extraction system downgradient of Site R. The following vertical distribution of Total SVOCs was found at two potential extraction well locations at the downgradient boundary of Site R:

Depth Below Ground Surface (feet)	Total SVOC Concentrations (ppb) Proposed Groundwater Extraction Well 1	Proposed Groundwater Extraction Well 2
Shallow Hydrogeologic Unit		
20	12	NS
30	1,042,800	146
40	NS	12,470
50	156,000	404,010
Middle Hydrogeologic Unit		
60	125,600	172,320
70	158,300	64,640
80	90,000	84,300
Deep Hydrogeologic Unit		
90	203,520	24,926
100	77,140	21,810 (2
110	107,400	
120	77,840 (1	

Notes: 1) Sample at termination depth of 116 ft BGS
2) Sample at termination depth of 98 ft BGS

Vertical stratification of SVOCs is also apparent from data collected at the location of Proposed Groundwater Extraction Well 2, with the highest concentrations in the SHU, lower concentrations in the MHU and lowest in the DHU. This vertical distribution pattern is different in Proposed Groundwater Extraction Well 1 where Total SVOC concentrations do not decrease with depth between the MHU and the DHU. While it is difficult to know with certainty the reason for this difference in vertical distribution between these two proposed well locations, it may be due to the presence of DNAPL at the bottom of aquifer. Proposed Groundwater Extraction Well 1 was located 650 feet south of the north end of Site R. As discussed above, Total VOC and SVOC highs in the SHU, MHU and DHU are located in the northern two thirds of Site R. With a history of both solid and liquid waste disposal that allegedly started at the north end of Site R and continued to the south, it seems reasonable to expect the presence of DNAPL beneath and downgradient of this portion of Site R.

Other Groundwater Investigations

In 1998, Ecology and Environment (E&E) prepared the report "Sauget Area 2 Data Tables/Maps for EPA Region 5." This report summarized existing data for each site along with other information compiled by E&E during its file searches of various agencies and organizations. It contains data from investigations conducted by Clayton Environmental Consultants, Dynamac, E&E, IEPA, Geraghty and Miller, Reidel Industrial Waste Management, Russell and Axon and EPA.

Historical groundwater data presented in the report shows a strong correlation between groundwater contaminants and the sediment data. As part of its 1998 report, E&E prepared isoconcentration maps showing Total VOC concentration in shallow wells, Total VOC concentration in intermediate/deep wells, Total BNA concentration in shallow wells and Total BNA concentration in intermediate/deep wells. These maps are included in the ROD as Figures 5-19, 5-20, 5-21 and 5-22, respectively. These isoconcentration maps show groundwater concentration highs in shallow wells at Sites O and R.

2001 EPA Removal Site Evaluation at the Clayton Chemical Facility

The Clayton Chemical facility is located adjacent to the Sauget Area 2 Site and upgradient of the groundwater contamination release to the Mississippi River adjacent to Sauget Area 2 disposal Site R and the resulting impact area. The facility is located at 1 Mobile Avenue, Sauget, Illinois, between Site O and the dogleg portion of Site Q, and was operated as a railroad repair yard from the 1930s to 1962, a crude oil topping plant from 1962 to the mid-1960s, and an oil and solvent reclamation facility from the mid-1960s until 1998. Clayton Chemical blended hazardous waste fuel for use by industrial furnaces. Its facility included on-site bulk and drum storage, waste materials processing for fuels, a liquid fuel blending storage tank system and solvent recovery units. Wastes were received by Clayton Chemical by either bulk or in containers. Wastes disposed at the Clayton Chemical facility included oil tank bottoms, white gas, and spent halogenated and non-halogenated solvents. Clayton Chemical Company was renamed Resource Recovery Group LLC in 1996. The Clayton Chemical facility ceased operating in 1998, and was the subject of an emergency response action by EPA in 2001. Groundwater samples collected as part of he 2001 EPA emergency response detected vinyl chloride, 1,1-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, 1,1,1-trichloroethane, 1,2-dichloroethane, benzene, trichloroethene, toluene, tetrachloroethene, and xylene above maximum contaminant limits (MCLs).

Sauget Area 1 Remedial Investigation

Pursuant to a CERCLA Section 106(a) AOC with the EPA, Solutia conducted an RI for the Sauget Area 1 site, which consists of three closed municipal/industrial landfills (Sites G, H, and I), one backfilled wastewater impoundment (Site L), one flooded borrow pit (Site M), one borrow pit backfilled with various waste materials (Site N), and Dead Creek. Sites G, H, I and L are located upgradient from the groundwater contamination release to the Mississippi River adjacent to Sauget Area 2 disposal Site R and the resulting impact area. The Sauget Area 1 RI indicates that only groundwater contamination from Site I is currently migrating to the Mississippi River.

Site I is an inactive landfill that occupies approximately 19 acres of land and is located north of Queeny Avenue, west of Falling Springs Road, and south of the Alton & Southern Railroad in the Village of Sauget, Illinois. Industrial, chemical and municipal wastes were disposed at Site I from approximately 1931 to 1957. The estimated volume of waste and contaminated fill material in Site I is 680,827 cubic yards. RI groundwater sampling activities included collecting twenty-eight discrete zone groundwater samples from three-well transects downgradient of Site I. Constituents detected in groundwater downgradient of Site I include benzene, chlorobenzene, 1,1-dichloroethene, cis/trans-1,2-dichloroethene, 1,4-dichlorobenzene, 4-chloroaniline, 2-chlorophenol, 2,4-dichlorophenol, 1,2,4-trichlorobenzene, n-nitrosodiphenylamine, Alpha-BHC, Delta-BHC at concentrations above Illinois Class I groundwater standards and federal MCLs. The groundwater contamin tion plume extends beyond the downgradient Sauget Area 1 Site boundary (Route 3) and likely extends to the Mississippi River in the vicinity of Sauget Area 2 Site R.

5.3.2 Fate and Transport

With groundwater flow rates of 4 to 6 feet per day, constituents migrating in the MHU and DHU could reach the Mississippi River in time periods as short as approximately 40 days and 25 days, respectively. Processes such as dispersion, dilution, biodegradation, adsorption, precipitation, etc. will retard or slow the movement of site-related constituents migrating toward the Mississippi River in the MHU and DHU. However, it is unlikely that these processes have much of an effect given the high groundwater flow velocities in the MHU and DHU and the short distance from Site R to the river.

6. CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

6.1 LAND USES

Heavy industry has been present on the east bank of the Mississippi River between Cahokia and Alton, Illinois for nearly a century. Industrial activity in the area peaked in the 1960s and local businesses have been closing ever since. Although heavy industry has shut down throughout the American Bottoms, Sauget Area 2 and the surrounding area is still highly industrialized. In addition to heavy industry, the area currently has warehouses, trucking companies, commercial facilities, bars, nightclubs, convenience stores and restaurants. A number of petroleum, petroleum product and natural gas pipelines are located in the area.

No residential land use is located immediately adjacent to or downgradient of Sites O, P, Q, R and S; the W.G. Krummrich plant and other industrial facilities in the Sauget area. Residential areas of Sauget and East St. Louis are separated from this area by other industries or undeveloped tracts of land. Limited residential areas exist approximately 3,000 feet to the northeast and southeast of these industrial facilities. Industrial areas exist approximately 2000 feet west of this area, across the Mississippi River, in the City of St. Louis, Missouri, with residential areas located further to the west.

Historically, the Sauget area and its surroundings were used for waste disposal. Six closed landfills (Sauget Area 2 Sites P, Q and R and Sauget Area 1 Sites G, H and I), four closed sludge lagoons (Sauget Area 2 Site O), a closed tank-truck wash-water lagoon (Sauget Area 1 Site L) and a waste disposal site (Site S) associated with an abandoned solvent reclamation facility (Resource Recovery Group) are located in the Sauget area.

The future land use assumptions for the Site and surrounding areas would be anticipated to be similar to the current land use.

6.2 GROUNDWATER USE

Historically, groundwater from the American Bottoms aquifer was a major source of water for the area and was used for industrial, public, and irrigation purposes. Groundwater levels prior to industrial and urban development were near land surface. Intensive industrial withdrawal and use and construction of a system of drainage ditches, levees, and canals to protect developed areas lowered the groundwater elevation for many years. However, by the mid-1980s, the groundwater levels increased due to reduced pumpage, high river stages, and high precipitation. Currently, no groundwater is being pumped from the American Bottoms aquifer in the vicinity of Sauget Area 2 for public, private or industrial supply purposes.

Groundwater is not a source of drinking water in the area. The Villages of Sauget and Cahokia have issued ordinances prohibiting the use of groundwater as a potable water source. These ordinances were issued in response to historic industrial use in the region, and resulting ground-water quality impairments. Groundwater use restrictions will likely remain in place for the foreseeable future due to the extent of the groundwater quality impairments.

Although agricultural land is found throughout the immediate project area, this land is apparently not irrigated. The nearest irrigated land, other than residential lawns and gardens, is located in the Schmids Lake-East Carondelet area, which is south of Old Prairie du Pont Creek.

6.3 SURFACE WATER USE

The source of drinking water for area residents is an intake in the Mississippi River. This intake is located at River Mile 181, approximately three miles north of Sauget Area 2. The drinking water intake is owned and operated by the Illinois American Water Company (IAWC) of East St. Louis, and it serves the majority of residences in the area. IAWC supplies water to Sauget. The Commonfields of Cahokia Public Water District purchases water from IAWC and distributes it to portions of Cahokia and Centerville Township. The Cahokia Water Department also purchases water from IAWC and distributes it to small residential areas in the west and southwest portions of Cahokia. Cahokia and Sauget both have city ordinances that prohibit use of groundwater as potable water. Public water supply is the exclusive potable water source in Sauget Area 2.

The nearest downstream surface-water intake on the Illinois side of the Mississippi River is located at River Mile 110, approximately 68 miles south of Sauget Area 2. This intake supplies drinking water to residents in the Town of Chester and surrounding areas in Randolf County, Illinois. The nearest potentially impacted public water supply on the Missouri side of the river is located at River Mile 149, approximately 29 miles south of the study area. The Village of Crystal City, Missouri (pop. 4,000), located 28 miles south of the area, utilizes a Ranney well adjacent to the Mississippi River as a source for drinking water.

7. SUMMARY OF SITE RISKS

7.1 HUMAN HEALTH RISK ASSESSMENT

Dynamac Corporation's Fort Lee, New Jersey office and Geraghty & Miller's Bethpage, New York office prepared a Human Health for Sauget Area 2 Site R using data collected during an RI/FS required by the 1992 AOC with IEPA.

7.1.1 Identification of Chemicals of Concern

Using data from prior site investigations, the risk assessors identified 29 chemicals of potential concern (COPCs):

VOCs	SVOCs	Pesticides/PCBs	Metals
· Benzene	· Aniline	· alpha-BHC	· Antimony
· Chlorobenzene	· 4-Chloroaniline	· PCBs	· Arsenic
· 1,2-Dichloroethane	· Naphthalene		· Beryllium
· Dichloroethylene	· 1,2-Dichlorobenzene		· Boron
· Methyl Chloride	· Nitrobenzene		· Nickel
· Methylene Chloride	· 2-Nitrochlorobenzene		· Thallium
· Tetrachloroethylene	· Phenol		· Cyanide
· Vinyl Chloride	· 2,4-Dimethylphenol		
	· 2-Chlorophenol		
	· 2,4-Dichlorophenol		
	· 2,4,6-Trichlorophenol		
	· Pentachlorophenol		

7.1.2 Exposure Assessment

The objective of the exposure assessment was to identify potential exposure scenarios by which contaminants of concern in site media could contact humans and to quantify the intensity and extent of that exposure. The conceptual site model depicting potential receptors and exposure pathways were presented in Section 5. Potential exposure pathways are summarized below:

Potential Exposure Pathway	Chemical Source	Potential Exposure Scenario	Potential Receptors
Direct Contact	Clay Cap	Dermal Contact with and Incidental Ingestion of Soil	On-Site Maintenance Workers
Air	Clay Cap	Inhalation of VOCs and Dust	On-Site Maintenance Workers
Surface Water	Groundwater Release to Surface Water	Dermal Contact with and Ingestion of River Sediments	Trespassing Users of Mississippi River
		Fish Ingestion	Commercial and Recreational Users of Mississippi River

Potential risks due to direct contact and subsequent ingestion or dermal adsorption of constituents in, or adjacent to, landfilled materials were considered low because:

- The site is located in an exclusively industrial area and is fenced and patrolled by security personnel effectively eliminating the potential for residential exposure;

- Workers are the only likely receptors to be present at the site and they would be present for limited periods of time to implement remedial actions or complete maintenance activities;

- A 2 to 6 ft thick, intact, highly-vegetated clay cover prevents direct contact with landfill contents; and

- Use of appropriate health and safety measures would limit worker exposures.

Potential risks due to direct contact with surface water were considered low because:

- Swimming does not occur locally due to the highly urbanized and industrialized nature of the Sauget area;

- Chemical concentrations are likely to be low due to high dilution; and

- Exposure while fishing or boating would only be associated with incidental splash that is typically transient in nature and results in limited skin contact.

Potential risks due to inhalation of wind-blown dust from the landfill surface or entrained in the atmosphere by vehicular traffic associated with on-site remedial activities were considered low because:

- A thick clay cap covers the landfill;

- The cap is in good condition;

- Heavy vegetative cover on the cap significantly limits dust emissions;

- With a depth to water averaging 12 ft, most excavated materials would be wet and not prone to dispersal by wind entrainment;

- Potentially-significant receptors were probably limited to on-site remediation workers with short term exposures; and

- Construction of a slurry wall and installation of a pump and treat system, the most likely remediation scenario, would not be likely to generate significant quantities of air-borne dust.

Potential risks due to inhalation of volatile organics from the landfill were considered low because:

- Remediation workers were the only potentially significant receptors;

- Escape of volatiles is limited by the vegetated, clay cap; and

- Most remediation activities would occur adjacent to but not in the landfill, thereby leaving the materials with the highest concentration of volatile chemicals undisturbed.

Potential risks due to ingestion of biota were considered significant because:

- The groundwater plume from the landfill released an estimated 77 pounds per day of organic chemicals into the Mississippi River;

- Fish could accumulate at least one of the organic chemicals (chlorinated nitrobenzene) identified in Site R groundwater; and

- Commercial fishing is known to occur in the Mississippi River and recreational fishing is believed to occur.

Potential risks flora and fauna were considered significant because:

- The groundwater plume from the landfill released an estimated 77 pounds per day of organic chemicals into the Mississippi River; and

- The Mississippi River is an active ecosystem.

7.1.3 Cancer Risks

Potential carcinogenic risks associated with realistic exposure scenarios for identified receptor groups indicated that the potential excess cancer risks for on-site workers and area residents consuming fish were less than 2.7 x 10^{-7} for all pathways combined. Even under worst-case exposure assumptions, the estimated excess lifetime carcinogenic risk for all pathways combined was 5.7 x 10^{-6}. Risk assessment results for the exposure pathways are summarized below:

Pathway	**Worst-Case Exposures**		**Average-Case Exposures**	
	On-Site Worker	**Local Resident**	**On-Site Worker**	**Local Resident**
Dermal Contact				
Surface Materials	4.5 x 10^{-7}	NA (1	6.2 x 10^{-8}	NA (1
Surface Water				
Adult	NA	1.3 x 10^{-6}	NA	NA
Child	NA	7.6 x 10^{-7}	NA	NA
Total	NA	2.1 x 10^{-6}	NA	NA
Incidental Ingestion				
Surface Materials	8.9 x 10^{-7}	NA	1.2 x 10^{-7}	NA
Surface Water				
Adult	NA	3.4 x 10^{-9}		
Child	NA	8.1 x 10^{-9}		
Total	NA	1.2 x 10^{-8}		
Inhalation				
Volatile Organics	9.5 x 10^{-7}	NA	1.1 x 10^{-8}	NA
Fish Ingestion				
Adult	NA	8.7 x 10^{-7}	NA	5.2 x 10^{-8}
Child	NA	4.9 x 10^{-7}	NA	2.9 x 10^{-8}
Total	NA	1.4 x 10^{-6}	NA	8.1 x 10^{-8}
Total	**2.3 x 10^{-6}**	**3.4 x 10^{-6}**	**1.9 x 10^{-7}**	**8.1 x 10^{-8}**
Overall Total (2	**5.7 x 10^{-6}**		**2.7 x 10^{-7}**	

Notes:

1) Not applicable, pathway not available to this receptor group.
2) Conservatively assumes that a receptor will be exposed via all pathways.

7.2.4 Non-Cancer Risks

With respect to noncarcinogenic hazards, the analysis indicated that the hazard indices for all receptor groups and pathways combined were less than one for realistic exposure scenarios. Under worst-case assumptions, the combined hazard index was also less than one. Risk assessment results for the exposure pathways are summarized below:

Pathway	Worst-Case Exposures		Average-Case Exposures	
	On-Site Worker	Local Resident	On-Site Worker	Local Resident
Dermal Contact				
Surface Materials	6.2×10^{-4}	NA [1]	3.1×10^{-4}	NA [1]
Surface Water				
Adult	NA	6.1×10^{-2}	NA	NA
Child	NA	2.2×10^{-1}	NA	NA
Incidental Ingestion				
Surface Materials	2.2×10^{-3}	NA	1.1×10^{-3}	NA
Surface Water				
Adult	NA	1.7×10^{-4}		
Child	NA	2.3×10^{-3}		
Inhalation				
Volatile Organics	5.0×10^{-3}	NA	2.1×10^{-4}	NA
Fish Ingestion				
Adult	NA	5.4×10^{-2}	NA	3.0×10^{-3}
Child	NA	1.7×10^{-1}	NA	1.0×10^{-2}
Total Adult	**7.9×10^{-3}**	**1.1×10^{-1}**	**1.6×10^{-3}**	**3.0×10^{-3}**
Total Child	**NA**	**3.9×10^{-1}**	**NA**	**1.0×10^{-2}**
Overall Total [2]	**5.1×10^{-1}**		**1.5×10^{-2}**	

Notes:

1) Not applicable, pathway not available to this receptor group.
2) Conservatively assumes that a receptor will be exposed via all pathways.

7.2 ECOLOGICAL RISK ASSESSMENT

7.2.1 Dynamac (1994)

In 1994, as part of the Human Health Risk Assessment prepared for the Site R RI/FS, Dynamac and Geraghty & Miller also prepared an Ecological Risk Assessment using data collected during the RI required by the IEPA AOC. Using data from prior site investigations, the risk assessors identified 29 chemicals of potential concern (COPCs).

Potential risks to flora and fauna were considered significant because:

- The groundwater plume from the landfill released an estimated 77 pounds per day of organic chemicals into the Mississippi River; and

- The Mississippi River is an active ecosystem.

The Dynamac and Geraghty & Miller Ecological Risk Assessment evaluated potential hazards to terrestrial biota qualitatively. Due to the poor habitat available to support terrestrial wildlife, the presence of a clay cap on the landfill and the highly industrialized nature of the study area, potential terrestrial-wildlife exposures were likely to be limited. Consequently, risks to terrestrial organisms were likely to be limited.

Potential risks to aquatic organisms associated with groundwater releases to surface water were assessed quantitatively. This was done through acute toxicity bioassays for five species exposed to groundwater collected from three perimeter wells. Chronic toxicity bioassays were done for the most sensitive species tested. Bioassay results were used to derive a no observed effects concentration (NOEC) for site groundwater. This data, coupled with data on groundwater and surface-water flow rates, was used to derive an aquatic hazard index as a theoretical estimate of the potential hazards to aquatic organisms. Utilizing a safety factor of 10, the aquatic hazard index was found to equal 4.4 under average river flow conditions with no assumption for attenuation of toxicity with downstream distance or losses of toxic chemicals due to volatilization, adsorption, etc.

Aquatic hazard index values greater than one suggested that, within the limitations of the methodology used to derive this number, potential impacts to aquatic life associated with contaminated groundwater being released to the river could not be ruled out. Two conservative assumptions were used in calculating these results:

- Application of a ten-fold safety factor to provide a margin of safety for more sensitive species than those used in the groundwater bioassays; and

- Use of a simple dilution model to estimate constituent concentrations in surface water.

Although the data indicate that groundwater flowing into the river could have a potential impact on aquatic organisms, actual impacts were unknown. Testing of river water downstream of the American Bottoms Regional Treatment Facility outfall indicated that aquatic toxicity could not be measured by use of standard bioassay techniques in samples of river water collected immediately adjacent to the landfill. Furthermore, the data indicated that attenuation of toxicity is likely to be significant.

Acute toxicity studies of river water samples collected near the landfill suggested that attenuation of toxicity was likely to be rapid.

7.2.2 Environmental Science and Engineering (1995)

Environmental Science and Engineering's Amherst, New Hampshire office completed an ecological risk assessment for Site R in May 1995. The purpose of this risk assessment was to evaluate the potential for any adverse effects that constituents from the site might have on downstream ecological receptors within or depended upon the Mississippi River.

A reconnaissance of Site R and surrounding area was performed on May 6, 1994. With the exception of a few trees, no natural (undisturbed) habitat appeared to remain on the site nor were any jurisdictional wetlands present. Birds were the only animals identified on site at the time of the visit. From the standpoint of terrestrial ecology, it was determined that all of the following factors precluded inclusion of a terrestrial component in the Ecological Risk Assessment:

- Presence of at least two feet of clean cap material;
- Lack of food and/or sparse vegetative cover;
- Low probability for recruitment of terrestrial species from surrounding areas; and
- Disturbed nature of the available habitat.

As a natural resource, the Mississippi River is considered very important. However, the urban environment between Sauget and St. Louis and the physical (e.g. docks, barges and transfer stations) and the chemical (e.g. the ABRTF outfall) disturbances in the river could lead to defining this reach as a stressed ecosystem. Rip-rap along the western edge of the site provided shoreline stability but less than adequate riparian habitat for wetland-dependent birds or mammals. Organic chemicals in groundwater and the potential for migration to the Mississippi River presented an exposure pathway and potential risk to aquatic biota. This potential migration pathway and risk were the focus of the Ecological Risk Assessment. Only impacts to aquatic receptors that were directly or indirectly dependent on the river were considered in this assessment. Aquatic biota residing within or dependent on the Mississippi River downstream of Site R were considered the ecosystem at risk for this risk assessment.

With the exception of three constituents (Naphthalene, 4-nitrodiphenylamine and 2,4-D), SVOCs observed in soil and groundwater at Site R consisted primarily of four classes of compounds: Anilines, Chlorobenzenes, Phenols and Nitroaromatics. Some of these constituents were considered to have the potential to cause adverse acute and/or chronic effects in fish and other aquatic biota. The central question of the risk assessment was "Do the concentrations of individual CO[P]Cs in the Mississippi River predicted by the groundwater flow model meet or exceed currently available criteria, standards, or toxicity endpoints for surface water and sediment?".

All of the conservatively derived Hazard Indices for surface water and sediment were below 1.0. Therefore, the COPCs associated with Site R posed no apparent threat to aquatic biota.

In the uncertainty analysis, ES&E stated that:

> "Realistically, concentrations of COPCs in the Mississippi River would be expected to be higher in surface water and sediment near the landfill as this assessment assumed "immediate" mixing across the river. However, a mixing zone study conducted for the American Bottoms Regional Wastewater Treatment Facility in Sauget indicated that mixing for a point source would be vertically complete approximately 1000 feet downstream of the release. As the release from the Site R landfill is a diffuse source, the mixing would be more efficient, and any putative impacts to biota would be very localized."

7.2.3 Menzie-Cura (2001)

Study Area - In June 2001, Menzie-Cura and Associates completed a Baseline Ecological Risk Assessment for the Mississippi River immediately downgradient of Site R. This baseline ecological risk assessment for the aquatic habitat adjacent to the W.G. Krummrich plant in Sauget, Illinois addressed surface water and sediment in the Mississippi River adjacent to Sauget Area 2 Site R (Figures 7-1, 7-2, 7-3 and 7-4). Study area boundaries, which extended approximately 2000 feet along the riverbank and 300 feet into the river channel, were defined during a reconnaissance survey completed in September 2000. The study area, defined using screening-level VOC analyses of sediment samples, is referred to as the Plume Discharge Area throughout the ecological risk assessment. In general, the study area is bounded by steep embankments lined with rip-rap. A few scattered structures, such as a wing dam and a sunken barge, offer some access points for aquatic birds and mammals and potential protection for fish. There were no bordering wetlands or appreciable bordering vegetation. No submerged or emergent vegetation was observed at the study area.

Surface water, sediment and fish tissues samples were collected in October and November 2000. River gage height varied from 2.03 feet to 0.08 feet, river depths ranged from 4 to 14.5 feet and flow varied from 78,800 to 97,500 cubic feet per second during the sampling effort. Both flow and gage height were below annual average for 2000:

	Mean Gage Height (Feet)	**Mean Stream Flow (Feet)**
Maximum	25.38	387,000
Average	6.04	135,716
Minimum	- 2.39	65,000

Reference areas were also selected during the ecological site reconnaissance and during the main sampling event. They were selected to represent industrial habitat comparable to the study area. One reference area with two sampling stations, one with coarse sediments and one with silty sediments, was located upstream of the study area just north of the old power plant and south of a railroad bridge. The shoreline is less obstructed than at the study area with the upland portion vegetated and grading into a sandy shoreline. A second reference area, also with one coarse sediment sampling station and one silty sediment sampling station, was located downstream near the Cahokia Chute and Arsenal Island. This reference area consists of a large sand bar, less-developed uplands, banks that provide direct access to the river and a number of partially-sunken snags. The upstream reference area is referred to as Upstream from the Plume Discharge Area (UDA) and the downstream reference area is referred to as Downstream from the Plume Discharge Area (DDA). All three habitats (PDA, UDA and DDA) are located in an industrialized area and there are a number of coal, grain and other barge terminals upstream of all the sampling areas.

Coarse sediment sampling stations contained over 90% fine to medium sand. Silty sediment sampling stations within the study area, UDA and DDA had similar clay components although the study area stations had a larger fine sand component. Coarse sediment TOC ranged from 324 to 700 mg/kg dry weight while silty sediment TOC ranged from 2,805 to 11,800 mg/kg dry weight. Dissolved oxygen, TDS and turbidity ranged from 7.62 to 10.57 mg/l, 287 to 367 mg/l and 34.4 to 55.6 NTU.

Analytical Data - Surface water, sediment and fish tissue analytical data are summarized in Tables 5-1, 5-2 and 5-3, respectively. Fish tissue data are summarized by species and by area in Table 5-4.

Three trophic levels of fish were sampled in the plume release area and in the upstream and downstream reference areas: 1) bottom feeder, 2) forager and 3) predator. Analytical results are summarized in Table 7-1. These results represent maximum detected concentrations of constituents present in whole body fish tissue samples collected in the plume release area. Results from whole body fish tissue samples collected upstream and downstream of the plume release area are also included in this summary. As can be seen from these data, eight constituents were only detected in the plume release area. Three SVOCs were only detected in fish tissue samples collected in the plume release area: 1,2-Dichlorobenzene; 1,4-Dichlorobenzene; and 2,4-Dichlorophenol. None of these concentrations exceed Toxicity Reference Values (TRVs). One herbicide, MCPP (Methyl Chlorophenoxy Propionic Acid) was only detected in the plume release area samples. Its maximum concentration in fish tissue was 8,600 ppb. MCPP is a broadleaf herbicide currently registered for use. LC50s for rainbow trout, sunfish and bluegill are 125 ppm, >100 ppm and 92 ppm, respectively. Reported biocentration factors (BCFs) range from 122 to 141 (low to moderate potential for bioaccumulation). Four pesticides were only detected in fish tissue samples from the plume release area: 4,4,4-DDD (6.7 ppb); alpha BHC (2.6 ppb); Endrin (15 ppb) and Heptachlor epoxide (5.3 ppb). Concentrations of 4,4,4-DDD; Endrin and Heptachlor epoxide were below their respective TRVs. There is no TRV for alpha BHC. PCBs were not detected in any of the fish tissue samples.

Toxicity Data - Surface water and sediment toxicity test results are summarized in Table 5-5. Benthic invertebrate community data are included in Table 5-6.

Sediment and surface water samples were collected at nine sampling stations in the Plume Discharge Area and acute and chronic toxicity testing were performed on these samples. Of these nine sampling stations, three showed benthic organism toxicity and three showed lotic organism toxicity:

	Sediment		Surface Water	
	Hyallela	**Fathead Minnow**	**Fathead Minnow**	**Cerodaphnia**
North Sampling Transect				
PDA - 8	No	No	No	Yes (1
PDA - 9	No	Yes (2 Yes (3	No	Yes (1
PDA - 10	No	No	No	No
Center Sampling Transect				
PDA - 5	Yes (4	Yes (4 Yes (5	No	Yes (1
PDA - 6	No	No	No	No
PDA - 7	No	No	No	No
South Sampling Transect				
PDA - 2	No	No	No	Yes (4 Yes (2 Yes (1
PDA - 3	No	Yes (2 Yes (3	No	Yes (4 Yes (1 Yes (2
PDA - 4	No	No	No	Yes (4 Yes (1 Yes (2

Notes:
1) Chronic Toxicity - Reproduction
2) Chronic Toxicity - Survival
3) Chronic Toxicity - Growth
4) Acute Toxicity - Survival
5) Acute Toxicity - Growth

Exposure Pathways - Potential complete exposure pathways in the study area include:

- Sediment to benthic invertebrates via direct contact and ingestion;

- Surface water to invertebrates and fish through direct contact and ingestion;

- Benthic biota to higher order predators (e.g. fish) through the food chain; and

- Fish to piscivorous fish, mammals and birds via ingestion.

Species selected as potential receptors represent the ecological community and its sensitivity to the contaminants of concern and were arrived at based, in part, on knowledge of the area and on discussions with EPA and local professional fishermen. The ecological receptors selected for evaluation included: benthic invertebrates as a prey base for fish, local fin fish, great blue heron, osprey and river otter. In this assessment, drum, gizzard shad and channel catfish represent major groups of fish in the Mississippi River. They represent a bottom feeder, forage fish and a predator/omnivore bottom-feeding fish, respectively.

Assessment Endpoints - Two assessment endpoints were used in this ecological risk assessment: 1) sustainability (survival, growth and reproduction) of warm water fish species typical of those found in similar habitats (incorporates the assessment of aquatic invertebrates); and 2) survival, growth and reproduction of local populations of aquatic wildlife represented by osprey, great blue heron and river otter.

Constituents of Potential Concern - COPCs included the following constituents:

	Sediment	Water	Fish
VOCs			
Acetone	●		
Benzene	●	●	
2-Butanone	●		
Carbon Disulfide	●		
Chlorobenzene	●	●	
Chloroethane	●		
Chloroform	●		
1,2-Dichloroethane	●	●	
cis-1,2-Dichloroethene	●		
Ethylbenzene	●	●	
Methylene Chloride	●		
4-methyl-2-Pentanone	●	●	
Tetrachloroethylene	●		
Toluene	●	●	
Trans-1,2-Dichloroethylene	●		

	Sediment	Water	Fish
Trichloroethylene	●	●	
Vinyl Chloride	●		
Xylenes	●	●	
SVOCs			
4-Bromophenylphenylether	●		
4-Chloroaniline	●	●	
2-Chlorophenol	●	●	
1,2-Dichlorobenzene	●	●	●
1,4-Dichlorobenzene	●		●
2,4-Dichlorophenol	●	●	●
2,4-Dimethlyphenol	●	●	
2,4-Dinitrotoluene	●		
2-Methylphenol			●
3-Methylphenol	●	●	
4-Methylphenol	●	●	
Naphthalene	●		
2-Nitroaniline	●		
Nitrobenzene		●	
Phenol	●	●	
2,4,6-Trichlorophenol	●	●	
Pesticides			
alpha-BHC			●
alpha-Chlordane			●
gamma-Chlordane			●
4,4'-DDD	●		●
4,4'-DDE			●
4,4'-DDT			●
Dieldrin			●
Endosulfan I			●
Endrin			●
Endrin aldehyde			●
Heptachlor epoxide			●
Herbicides			
2,4-D	●	●	
Dicamba		●	
Dichloroprop	●	●	
MCPP	●		●
Pentachlorophenol	●	●	
2,4,5-T			●
Silvex		●	●
Dioxin	●	●	●

Surface Water and Sediment Impact - The only COPCs in surface water that exceeded available guidelines (Tier II secondary chronic) were dioxin TEQs (Toxicity Equivalency Quotients) for mammals and birds at all study area stations and reference stations and m&p xylene at one PDA station. A conclusion of no significant risk from exposure to these COPCs could not be made based on the guideline comparison.

Sediment and surface water toxicity tests for analysis of survival and growth of fish result in toxicity at certain stations. The sediment toxicity tests indicated a significant reduction in survival at sand stations PDA-5 and PDA-9 and silt station PDA-3 (and PDA-3FD) in reference to controls; all three stations also resulted in a significant reduction in survival in comparison to all other study area, UDA and DDA stations except DDA-13 (sand). PDA-5 is 50 feet from shore on the middle transect, PDA-9 is 150 feet from shore on the northern transect and PDA-3 is 150 feet from shore on the southern transect. VOCs and herbicides (2,4-D, MCPP) are elevated at these stations. No significant reduction in growth was observed, excluding PDA-5, PDA-9 and PDA-3 (3FD). The surface water toxicity tests resulted in a significant reduction in survival at seven days in reference to laboratory controls for both downstream reference areas. The sediment fish toxicity tests indicate potential reductions in survival for fish exposed to study area sediment with effects localized to samples approximately 150 feet from shore or less.

The components of the sediment triad include the sediment COPC screening, benthic community analysis and benthic invertebrate sediment toxicity testing. The COPC screening resulted in one guideline exceedance for naphthalene. The naphthalene concentration in sediment at PDA-3 exceeded the TEC (Threshold Effects Concentration). Risk due to guidelines exceedances is low, however, there are a number of compounds without applicable guidelines. The benthic community analysis was confounded by the high-energy conditions of the environment at study area (coarse grain and high current exposure). The study area benthic community included few taxa and low abundance. A similarly sparse community was found in the UDA samples. The DDA samples included a greater diversity and abundance. Because observations are confounded by the high-energy nature of the environment, this component of the triad is inconclusive. Because of the nature of the environment, the benthic community was predicted not to be a significant component of the fish prey base. Plankton, drift and periphytic communities are likely to be more important components of the fish prey base. Finally, the sediment toxicity tests with a benthic invertebrate resulted in a significantly lower survival in PDA-5 compared to the laboratory control and all other sand study area, DDA and UDA stations. No silt stations resulted in a significant reduction in survival. Growth was not significantly lower in all stations with the exception of PDA-5. PDA-5 is approximately 50 feet from shore and has elevated VOCs (clorobenzene, xylenes) and herbicides (2,4-D, MCPP and dichloroprop). The sediment triad component, toxicity testing, indicates impairment of the benthic community from exposure to sediments at PDA-5.

Surface water toxicity testing for the planktonic invertebrate, Ceriodaphnia dubia, resulted in significantly lower survival at 2 days and 7 days at PDA-2, PDA-2FD, PDA-3 and PDA-4 compared to control samples and all other samples. Both PDA -2 and PDA -2FD resulted in 0% survival at Day 2. Stations PDA-2 through PDA-4 comprise the southern, silty transect in the study area (50, 150 and 300 feet from shore, respectively). These stations have elevated SVOCs (4-chloroaniline), VOCs (chlorobenzene) and herbicides (2,4-D). Reproduction also was significantly reduced at PDA-5 (50 feet from shore on the middle transect) compared to the controls and all other stations, and at PDA-8 and PDA-9 in reference to two controls, but not the reference areas. The surface water planktonic invertebrate tests indicate a potential risk to planktonic invertebrates in terms of survival, and at one station, reproduction. However, it was assumed that water-column plankton were exposed to surface water at the sediment/surface water interface. The toxicity test exposures the plankton to this surface water for seven days. This is a conservative assumption because the surface water in the study area undergoes dynamic mixing and dilution continuously and water column plankton integrate exposures throughout the water column in the high energy environment.

Fish Impact - Several COPCs including dioxin, herbicides, pesticides and SVOCs were detected in fish from the study area at concentrations higher than those detected in fish from the UDA and/or the DDA reference areas, indicating that fish at the study area have a higher exposure. Of the COPCs detected in fish tissue, the study area fish tissue concentrations with available TRVs (Toxicity Reference Values) do not exceed the No Effect TRVs. However, TRVs are not available for some COPCs, particularly the phenoxy herbicides. For those compounds without TRVs, the comparison indicates that study area fish have a higher exposure than reference fish for a subset of detected COPCs. There is some uncertainty in this line of evidence because of the lack of TRVs for some compounds.

Fish species are at risk from direct exposure to study area sediments and due to threats to the prey base in sediment and surface water based on toxicity test results. However, based on the benthic survey information, the physical environment inherent to the Mississippi River under high-energy conditions reduces the importance of the benthic community as a prey base for fish communities. Planktonic invertebrates do serve as a prey base for fish species, however, the assessment assumes that they are exposed to dynamic water concentrations reflecting dilution and dispersion in the high-energy environment. Direct comparisons of COPC concentrations to guidelines indicate limited risk from exposure to a few compounds. Study area -specific COPCs, such as MCPP (Methyl Chlorophenoxy Propionic Acid), are present in study area sediment and fish tissue and are not detected in UDA or DDA samples indicating that the compounds are accumulating.

Wildlife Impact - Wildlife observations, specifically fish diversity, is similar at the study area, DDA and UDA. Habitat between these areas differs physically (study area steep and rocky shoreline) which may affect wildlife use, but this difference is not due to COPC concentrations. Comparison of COPC concentrations in surface water to wildlife drinking water benchmarks (NOAELs) indicated that no COPC for which there is a benchmark exceeded that benchmark.

Analysis of wildlife (birds and mammals) that utilize fish as a prey base and may be incidentally exposed to study area surface water and/or sediment and consume fish indicates that there is no significant risk of harm from exposure to study area media for any COPC with a TRV. However, no TRV was available for MCPP and other phenoxy herbicides and COPCs. MCPP is detected in study area sediment and fish tissue, but not in DDA or UDA sediment or fish tissue. Therefore, there is some uncertainty in this endpoint.

The analysis of potential risk to local populations for wildlife as represented by two bird and one mammal receptor species exposed to study area sediment, surface water and fish tissue indicates a low potential for risk. Observations do not indicate clear impacts to wildlife populations utilizing the study area.

In general, the impacts occur within 300 feet of shore. The toxicity tests indicate toxicity at four stations within 150 feet of shore. The surface water at one station, PDA-4, results in water column toxicity and is located approximately 300 feet from shore. This station is located downstream from the wing dam and is somewhat protected from river currents.

Summary - Menzie-Cura's Ecological Risk Assessment indicates that:

- Fish species are at risk from exposure to sediment based on the results of toxicity testing;

- Fish prey, such as planktonic invertebrates, are at risk from exposure to surface water based on toxicity tests. Planktonic invertebrates do serve as a prey base for fish species, however, the assessment assumes that they are exposed to surface water at the sediment-surface water interface. In reality, they are exposed to dynamic water concentrations reflecting dilution and dispersion in the high-energy riverine environment. Benthic organisms are also at risk from exposure to sediment based on laboratory toxicity tests. However, the inherent high-energy physical environment in the study area in the Mississippi River limits the number of benthic invertebrates. Therefore, benthic invertebrates are not abundant and are not considered an important prey component for fish at the study area.

- Fish are accumulating compounds, specifically MCPP [methyl-chlorophenoxy-propionic acid], detected in study area sediments but not detected in reference sediments.

- There is a low potential risk to wildlife foraging on the media (sediment, surface water and fish) in the study area.

- There are a number of compounds without applicable sediment, surface water or tissue guidelines. Comparisons of study area concentrations to reference concentrations indicate that a subset are found in concentrations in study area media that exceed the concentrations in reference media.

- In general, the impacts occur within 300 feet of the shoreline. All toxicity tests resulting in potential toxicity occurred within 150 feet of shore, with the exception of one station (PDA-4) at 300 feet. This station is located downstream of the wing dam in an area where surface waters are more protected from the strong currents.

- VOCs, SVOCs, and one herbicide are elevated at the surface water stations with toxicity, and VOCs, and herbicides are elevated at the sediment stations with toxicity.

7.3 BASIS FOR RESPONSE ACTION

While the human health risk assessment for Site R indicated there is no unacceptable risk to human receptors due to site-related COCs, the June 2001, Menzie-Cura and Associates ecological risk assessment revealed that fish species are at risk from exposure to sediment, fish prey are at risk from exposure to surface water, and a number of compounds found in sediment, surface water and fish tissue were not found in reference areas. As such, actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

8. INTERIM REMEDIATION OBJECTIVES

Based on the risks associated with the release of impacted groundwater to surface water downgradient of Sauget Sites O, Q (dog leg), and R; Sauget Area 1 Site I; the W.G. Krummrich plant, Clayton Chemical Facility and other industrial facilities in the Sauget area, the following Remedial Action Objectives were identified for the Interim Groundwater Remedial Action:

- Protection of aquatic life in surface water and sediments from exposure to site contaminants;
- Prevent or abate actual or potential exposure to nearby human populations (including workers), animals or the food chain from hazardous substances, pollutants or contaminants;
- Prevent or abate actual or potential contamination of drinking water supplies and ecosystems;
- Achieve acceptable chemical-specific contaminant levels, or range of levels, for all applicable exposure routes;
- Mitigate or abate the release of contaminated groundwater in the plume area to the Mississippi River so that the impact is "insignificant" or "acceptable" as required by the May 3, 2000 W.G. Krummrich RCRA AOC (EPA Docket No. R8H-5-00-003).

An Interim Groundwater Remedy can be implemented to abate aquatic impacts while the Sauget Area 2 RI/FS is being performed to evaluate remedial alternatives that will abate impacts on groundwater. Once the Sauget Area 2 RI/FS is completed, a Final Groundwater Remedy will be selected.

Mass loading, gradient control and sediment and surface water monitoring are appropriate performance measures for the Interim Groundwater Remedy remedial action objectives outlined above.

9. DESCRIPTION OF ALTERNATIVES

This Section provides a narrative summary of each alternative evaluated to address the release of contaminated groundwater to the Mississippi River. An ecological risk assessment performed in June 2001 indicates there is an adverse impact on the Mississippi River resulting from the release of groundwater from Sauget Area 2 Sites O, Q (dog leg), and R; Sauget Area 1 Site I; the W.K. Krummrich plant, the Clayton Chemical Facility, and other industrial facilities in the Sauget area. Based on this risk assessment, it is appropriate to take an Interim Remedial Action to protect the Mississippi River before the Sauget Area 2 RI/FS is completed, the Sauget Area 1 ROD is issued and the RCRA Corrective Measures Study is performed for the Krummrich plant. An engineered barrier located at the downgradient edge of the impacted groundwater plume is the only effective interim remedy that will achieve the objective of protecting the Mississippi River. For that reason, only three alternatives were compared in this Focused Feasibility Study and summarized below.

Alternative 1 - No Action

The "No Action" alternative represents a baseline against which the effectiveness of other groundwater alternatives can be compared. This alternative includes no actions to abate the impact of groundwater being released to surface water downgradient of Sauget Area 2 Site R. Implementation of a No Action alternative will not protect the Mississippi River from adverse ecological impact due to the release of impacted groundwater to surface water and will not address the primary potential risk to human health. In addition, a No Action alternative is unlikely to be effective or permanent in the long-term because it does not provide for treatment beyond that afforded by natural processes. This alternative is readily implementable and there are no costs are associated with implementation.

Alternative 2 - Physical Barrier, Groundwater Treatment, Groundwater Quality Monitoring, Groundwater Level Monitoring, Sediment and Surface Water Monitoring, and Institutional Controls

Physical Barrier - A 3,500 foot long, "U"-shaped, fully penetrating, jet grout barrier wall will be installed between the downgradient boundary of Sauget Area 2 Site R and the Mississippi River to abate the release of impacted groundwater (Figure 9-1). It will extend along the entire 2,000 feet north/south length of Site R with the arms of the "U" extending approximately 750 feet to the east (upgradient), past the eastern boundary of Site R and terminating before the USACE floodwall. Three partially penetrating groundwater recovery wells will be installed inside the "U"-shaped barrier wall to control groundwater moving to the wall.

Groundwater Treatment - Extracted groundwater will be treated to meet all relevant and appropriate discharge requirements.

Groundwater Quality Monitoring - Groundwater quality samples will be collected downgradient of the engineered barrier to determine mass loading to the Mississippi River resulting from any contaminants migrating through, past or beneath them.

Groundwater Level Monitoring - Groundwater level monitoring will be done to ensure acceptable performance of the physical barrier. Groundwater elevation data from water-level measurement piezometers can be used to assess whether or not gradient control is achieved if a physical or hydraulic barrier is installed to abate the release of impacted groundwater to the Mississippi River.

Sediment and Surface Water Monitoring - Sediment and surface water samples will be collected in the plume release area to determine the effect of any contaminants migrating through, past or beneath the barrier wall and being released to the Mississippi River.

Institutional Controls - Institutional controls will be utilized to limit fishing in the plume release area by limiting site access, posting warning signs, and implementing a public education program.

Alternative 3: Hydraulic Barrier, Groundwater Treatment, Groundwater Quality Monitoring, Groundwater Level Monitoring, Sediment and Surface Water Monitoring, and Institutional Controls

This alternative includes groundwater treatment, groundwater quality monitoring, water level monitoring, sediment and surface water monitoring, and institutional controls previously discussed under Alternative 2.

Hydraulic Barrier - Three partially penetrating groundwater recovery wells, capable of pumping a combined total of 606 to 1,448 gpm, will be installed downgradient of Sauget Area 2 Site R to abate the release of impacted groundwater to surface water to the point where the impact on the Mississippi River is reduced to acceptable levels (Figure 9-2).

10. COMPARATIVE ANALYSIS OF ALTERNATIVES

Section 121(b)(1) of CERCLA presents several factors that at a minimum EPA is required to consider in its assessment of alternatives. Building upon these specific statutory mandates, the NCP articulates nine evaluation criteria to be used in assessing the individual remedial alternatives. The purpose of this evaluation is to promote consistent identification of the relative advantages and disadvantages of each alternative, thereby guiding selection of remedies offering the most effective and efficient means of achieving site cleanup goals. While all nine criteria are important, they are weighed differently in the decision-making process depending on whether they evaluate protection of human health and the environment or compliance with Federal and State requirements, standards, criteria, and limitations (threshold criteria); consider technical or socioeconomic merits (primary balancing criteria); or involve the evaluation of non-EPA reviewers that may influence an EPA decision (modifying criteria).

10.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

This criterion evaluates whether an alternative achieves and maintains adequate protection of human health and the environment. Alternative 1 - "No Action" would not provide adequate protection to human health and the environment because it would not eliminate, reduce, or control the existing threats to public health and the environment. The June 2001 Ecological

Risk Assessment demonstrated that groundwater being released to surface water is adversely impacting sediment and surface water in the Mississippi River. In addition, site-specific compounds were present in fish tissue collected in this area at higher concentrations than were detected in fish tissue collected upstream and downstream of the plume release area. Because the "No Action" alternative is not protective of human health and the environment, it was eliminated from consideration under the remaining eight criteria.

Alternative 2 and 3 would protect the Mississippi River from adverse ecological impacts resulting from impacted groundwater being released to surface water. Protection will be achieved by capturing impacted groundwater that results in surface water and sediment toxicity and fish tissue bioaccumulation. Performance of groundwater quality, groundwater level and sediment and surface water monitoring will ensure that interim remedial action objectives are met. These alternatives include institutional controls as an added means of protecting human health.

10.2 COMPLEANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

Section 121(d) of CERCLA requires that remedial action at CERCLA sites at least attain legally applicable or relevant and appropriate federal and State requirements, standards, criteria, and limitations which are collectively referred to as "ARARs", unless such ARARs are waived under CERCLA section 121(d)(4).

Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or State environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those standards that are identified by a State in a timely manner and that are more stringent than federal requirements may be applicable. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or State environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site. Only those State standards that are identified in a timely manner and are more stringent than federal requirements may be relevant and appropriate.

Compliance with ARARs addresses whether a remedy will meet all of the applicable or relevant and appropriate requirements of other Federal and State environmental statutes or provides a basis for invoking a waiver. The type of legal requirements applying to Superfund responses will differ to some extent depending upon whether the activity in question takes place on site or off site. Congress limited the scope of EPA's obligation to attain administrative ARARs through CERCLA §121(e), which states that no federal, State, or local permits are required for on-site Superfund response actions. This permit exemption allows the response action to proceed in an expeditious manner, free from potentially lengthy delays associated with the permit process.

ARARs are categorized as chemical-specific, location-specific, or action-specific.

Chemical-specific ARARs define acceptable concentrations and are used to establish preliminary remediation goals. State and federal surface water criteria and drinking water standards are appropriate chemical-specific ARARs for ground-water quality. This interim action will only address those risks associated with the release of impacted groundwater to surface water identified in the 2001 ecological risk assessment. EPA will continue to collect the necessary data through the RI/FS process in order to develop options for a long-term comprehensive groundwater cleanup for Area 2. Due to the limited scope of the interim action, EPA will be invoking an interim action waiver of chemical-specific ARARs. An interim action waiver is appropriate where a requirement that is an ARAR cannot be met as part of the interim remedy, but will be attained by the final site remedy.

Location specific ARARs set restrictions on activities within certain locations such as floodplains or wetlands. Alternatives 2 and 3 would be compliant with location specific ARARs.

Action-specific ARARs set controls for particular treatment and disposal activities related to the management of hazardous waste. Alternative 2 and 3 are expected to comply with action-specific ARARs.

10.3 LONG-TERM EFFECTIVENESS AND PERMANENCE

Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once clean-up levels have been met. This criterion includes the consideration of residual risk that will remain onsite following remediation and the adequacy and reliability of controls.

The long-term effectiveness of Alternative 2 depends on the structural integrity of the physical barrier and the continued operation of the groundwater extraction system. Following proper design and installation, this alternative should effectively control the release of contaminated groundwater to surface water. Alternative 2 offers the benefit of reducing the reliance of a mechanical pumping system that may occasionally fail and that would require shutdown for maintenance. The engineered barrier would prevent the immediate release of contaminated groundwater to the Mississippi River. The effectiveness of Alternative 3 depends on the integrity of the extraction system; however, continuous operation of Alternative 3 should effectively control the release of contaminated groundwater into the Mississippi River. Monitoring the effectiveness of Alternative 3 would be more difficult than Alternative 2 due to the inability to collect groundwater quality data outside the influence of the extraction system in a down gradient direction.

10.4 REDUCTION IN TOXICITY, MOBILITY AND VOLUME THROUGH TREATMENT

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of the remedy.

Alternatives 2 and 3 utilize conventional technologies that have been proven effective in reducing the toxicity, mobility, and volume of contaminated groundwater by providing hydraulic control and removal of affected groundwater before it releases to the Mississippi River.

10.5 SHORT-TERM EFFECTIVENESS

Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community and the environment during construction and operation of the remedy until cleanup levels are achieved.

Alternatives 2 and 3 would not pose a substantial risk during construction and operation. Short-term risk to workers associated with normal construction hazards and potential contact with contaminated water will be eliminated through appropriate controls and adherence to proper health and safety protocols. Investigation-derived waste and purge water produced during well development and sampling will be managed and disposed of as provided for in an appropriate sampling and analysis plan. Extracted groundwater will be treated and discharged in compliance with all applicable standards and permits. Alternative 3 more quickly mitigates the adverse surface water impacts resulting from groundwater being released to the Mississippi River because it can be implemented sooner than Alternative 2. Consequently, Alternative 3 is more effective in the short term than Alternative 2.

10.6 IMPLEMENTABILITY

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.

Alternative 3 can be implemented more readily than Alternative 2 because installation of a physical barrier is not included in this alternative. Installing a physical barrier to depths of 120 feet will be difficult, but within the capabilities of available technology. Both Alternative 2 and Alternative 3 include groundwater extraction and treatment. Additional time will be required to plan, design, procure and install the extraction and treatment system. Both of these alternatives are implementable with conventional materials and equipment.

10.7 COST

This criterion includes estimated capital and operation and maintenance costs as well as present worth costs. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent.

The present worth cost for Alternative 2 is $ $26,586,366. The present worth cost for Alternative 3 is $50,338,199. Alternative 3 ($50.3MM) is significantly more expensive than Alternative 2 ($26.5MM) on a 30-year present value basis. A summary of all the alternative's costs is provided below. No costs are associated with Alternative 1.

Project Element	**Alternative 2** (Physical Barrier)	**Alternative 3** (Hydraulic Barrier)
Institutional Controls	$248,181	$248,181
Monitoring	$1,845,527	$1,845,527
Barrier	$7,045,794	$1,023,821
Groundwater Treatment	$17,446,864	$47,220,670
30-Year Present Value Cost	$26,586,366	$50,338,199

10.8 STATE ACCEPTANCE

The IEPA has indicated it's intention to concur with the Selected Remedy. The Letter of Concurrence will be added to the Administrative Record upon receipt.

10.9 COMMUNITY ACCEPTANCE

This criterion evaluates whether the local community agrees with EPA's analyses and preferred alternative. Very few comments were received regarding the Proposed Plan for the Site. Based on its communications and contacts with the community, EPA believes the community would be supportive of Alternatives 2 or 3.

11. SELECTED REMEDY

11.1 SUMMARY OF THE RATIONALE FOR THE SELECTED REMEDY

The selected remedy is considered an interim remedial action for the groundwater operable unit (OU-2) Sauget Area 2 Site. This limited-scope action is intended only to address the release of contaminated groundwater into the Mississippi River in the vicinity of Site R and the associated risks. Operation of the physical barrier and groundwater extraction system will provide additional information to be used in developing options for a final long-term comprehensive groundwater remedy.

A final response action to address fully the threats posed by conditions at the Sauget Area 2 Site will be taken upon completion of the Sauget Area 2 RI/FS in 2004. The selected remedy includes a physical barrier, groundwater treatment, institutional controls, groundwater quality, groundwater level and sediment and surface water monitoring, is the proposed preferred alternative that was identified in the Proposed Plan.

11.2 DESCRIPTION OF REMEDIAL COMPONENTS

The major components of the remedy are:

- **Physical Barrier** - A 3,500 ft. long, "U"-shaped, fully penetrating, jet grout barrier wall will be installed between the downgradient boundary of Sauget Area 2 Site R and the Mississippi River (Figure 9-1) to abate the release of impacted groundwater. The purpose of the barrier wall is to minimize the volume of groundwater that has to be extracted to ensure equal heads on both sides of the wall. It will extend along the entire 2,000 ft. north/south length of Site R with the arms of the "U" extending approximately 750 feet to the east (upgradient), past the eastern boundary of Site R and terminating before the U.S. ACE floodwall.

  The barrier wall will be taken to the top of the bedrock surface which is expected to be in the range of 120 to 140 feet deep. The injection holes will be drilled a few feet into the rock to ensure that the injection ports are at the same elevation as the top of the rock.

  The geometry and installation methods for the wall will be optimized during the remedial design. The jet grout system allows the physical barrier to be constructed in a number of different ways including intersecting panels, half columns, and columns. At this time, it appears that the use of intersecting panels may best suit the conditions of the Site in terms of constructability and ease of installation. These panels can vary in thickness between 4 to 6 inches and 2 feet, and will intersect at a shallow angle with overlap past the point of intersection.

  The jet grout wall is expected to produce a continuous barrier with minimal gaps. Minor discontinuities may occur because of very localized geologic variations. These discontinuities, if they exist, are expected to be very minor and will not materially affect the performance of the system. Larger discontinuities will be identified by the QA/QC program and addressed.

Quality control measures will include the construction of test cells prior to wall construction and evaluation of the integrity by performing a pump drawdown test within the cell, pre-drilling the grout injection holes and gauging each hole with an inclinometer to ensure verticality, and coring the completed panels at regular intervals to check for strength and soil-grout consistency.

The approximate spacing of grout injection points will be finalized in the field on the basis of test panel construction. The spacing is dependent on a number of variables, including the equipment used by the contractor, injection pressures, mix design, and site specific geologic conditions. Spacing is anticipated to be somewhere in the range of 5 to 10 feet. Only one row of injection points is planned since the panel sections will be angled to intersect each other.

- **Groundwater Extraction** - Three partially penetrating groundwater recovery wells, capable of pumping a combined total of 303 to 724 gpm, will be installed inside the "U"-shaped barrier wall to abate groundwater moving to the wall. Modeling indicates that groundwater is released to the Mississippi River for high, average and low river stage conditions at 303, 535 and 724 gpm, respectively (Volume II - Design Basis and Design).

- **Groundwater Treatment** - Once extracted, the contaminated groundwater would be treated and ultimately discharged to the Mississippi River. Several groundwater treatment options are currently being evaluated. Selection of the actual treatment technologies and the location of the treatment system will be determined during the remedial design.

The treatment component of the groundwater alternative will utilize presumptive technologies identified in EPA's groundwater presumptive strategy, "Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Groundwater at CERCLA Site", October 1996, Office of Solid Waste and Emergency Response (OSWER) Directive 9283.1-12 (Appendix C to the ROD). Since contaminants of concern include volatile and semivolatile organic compounds, one or more of the presumptive technologies - air stripping, granular activated carbon (GAC), chemical/UV oxidation and aerobic biological reactors - will be used for treating aqueous contaminants in the extracted groundwater. Other technologies may also be needed in the treatment system for removal of suspended mineral solids and treatment of vapor phase contaminants. The actual technologies and sequence of technologies used for the treatment system will be determined during the remedial design. Final selection of these technologies will be based on additional site information to be collected during the remedial design. Based on this information and sound engineering practice, the treatment system shall be designed to attain the chemical-specific discharge or pretreatment requirements and other performance criteria in compliance with ARARs. Other design factors shall include maximizing long-term effectiveness, maximizing long-term reliability (i.e., minimizing the likelihood of process upsets), and minimizing long-term operating costs. Treated groundwater would ultimately be discharged to the Mississippi River.

Additional information concerning presumptive technologies for the ex-situ treatment component of the remedy is provided in OSWER Directive 9283.1-1-12. Descriptions of each of the presumptive technologies are presented in Appendices D1 through D8, and advantages and limitations of each of these technologies are listed in Appendix C4 of this directive.

For the purpose of estimating the approximate cost of the treatment component of the selected remedy, it was assumed that extracted groundwater would be routed to the American Bottoms Regional Treatment Facility (ABRTF) via subsurface pipeline which would connect with the Village of Sauget trunk sewer leading to the PChem Plant.

- **Groundwater Quality Monitoring** - Groundwater quality samples will be collected downgradient of the physical barrier to determine mass loading to the Mississippi River resulting from any contaminants migrating through, past or beneath the barrier wall. Groundwater quality samples will be collected from four monitoring well clusters and analyzed for VOCs, SVOCs, Herbicides, Pesticides and Metals. TOC and TDS will also be determined for each sample. Each well cluster will consist of monitoring wells screened in the Shallow, Middle and Deep Hydrogeologic Units. A total of twelve monitoring wells will be installed. Figure 9-1 depicts the planned monitoring well network. Groundwater samples will be collected quarterly until the final groundwater remedy and associated groundwater monitoring program for the Sauget Area 2 Site is in place. Mass loading for each hydrogeologic unit will be calculated using average TOC and TDS concentration in the unit. Total mass loading to the Mississippi River will be determined by summing the mass loads for the SHU, MHU and DHU. Total mass loading will be plotted over time to track changes in the amount of mass being released to the Mississippi River.

- **Groundwater Level Monitoring** - Groundwater level monitoring will be done to ensure acceptable performance of the physical barrier. Soil samples from the borings completed for the purpose of installing water-level piezometers will be screened for the presence of NAPL. In addition, existing wells downgradient of Sauget Area 2 Site R will be measured for accumulation of NAPL.

  Groundwater levels will be monitored at the physical barrier to determine if gradient control is achieved. Gradient control will be determined by:

  - Comparing the water-level elevations in pairs of fully penetrating water-level piezometers installed at the northwest corner of the barrier wall, southwest corner, halfway between the south pumping well and the center pumping well, and halfway between the north pumping well and the center pumping well (Figure 9-1). One piezometer of each pair will be installed inside the barrier wall and one will be installed outside it. Pumping rates will be adjusted so that the water-level elevation in the inside piezometer is the same as the water-level elevation in the outside piezometer. This will ensure that groundwater moving to the physical barrier is controlled. Electronic water-level recorders will be installed in each piezometer and telemetry will be used to send the water-level data to the pump controller. Groundwater elevations inside and outside the barrier wall will be compared by the pump controller and pumping rates will be adjusted to maintain the same groundwater level elevation inside the barrier wall as measured outside the wall.

  - Groundwater levels will be measured manually on a quarterly basis in existing wells B-21B, B-22A, B-24C, B-25A, B-25B, B-26A, B-26B, B-28A, B-28B and B-29B to supplement gradient control information from the water-level piezometers.

- **Sediment and Surface Water Monitoring** - Sediment and surface water samples will be collected in the plume release area to determine the effect of any contaminants migrating through, past or beneath the barrier wall and being released to the Mississippi River. Impact will be determined by comparing constituent concentrations to site-specific, toxicity-based, protective concentrations derived from existing sediment and surface water chemistry and toxicity data. An Apparent Effects Threshold approach will be used to derive site-specific, protective constituent concentrations for sediments and a Toxic Units approach will be used to derive site-specific, protective constituent concentrations for surface water.

  Surface water and sediment samples will be collected at Sediment Sampling Stations - 2, 3, 4, 5 and 9, where toxicity was observed in October/November 2000, and analyzed for VOCs, SVOCs, Herbicides, Pesticides and Metals. Constituent concentrations will be plotted as a function of time and compared to the site-specific, toxicity-based, protective concentrations to determine progress toward achieving these targets.

  Sediment and surface water sampling will be conducted twice a year, once during the summer low flow period and once during the winter low flow period, when groundwater being released to the Mississippi River is high.

- **Institutional Controls** - This alternative includes institutional controls in combination with a well-designed performance-monitoring program. Institutional controls will be utilized to limit fishing in the plume release area while performance monitoring will be used to evaluate the effectiveness of the physical barrier in mitigating or abating the release of groundwater to the Mississippi River so that the impact is "insignificant" or "acceptable".

  Access to the Mississippi River in the plume release area is limited by existing fencing at Site R, a very steep riverbank and the absence of public roads leading to this area. Additional institutional controls would include warning signs posted at the top of the riverbank in the plume release area and in nearby river access areas. A public education program would be implemented by the appropriate government agencies to inform the public that fish in the impacted groundwater release area may contain site-related constituents and to assure public awareness of the potential risks, if any, that may be associated with consumption of fish caught in the plume release area.

Routine maintenance and inspection of the condition and effectiveness of the institutional controls will be performed. For estimating purposes, it is assumed that inspections will be conducted quarterly.

11.3 SUMMARY OF THE ESTIMATED REMEDY COSTS

The present worth cost for the selected remedy is $26,586,366. A more detailed cost estimate summary for the selected remedy is provided in Table 11-1.

The information in this cost estimate summary table is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. Major changes may be documented in the form of a memorandum in the Administrative Record file, an ESD, or a ROD amendment. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual cost.

11.4 EXPECTED OUTCOMES OF THE SELECTED REMEDY

The Selected Remedy will greatly reduce the environmental impacts associated with the release of contaminated groundwater to the Mississippi River in the vicinity of Sauget Area 2 Site R. This will be accomplished through the containment and extraction of contaminated groundwater downgradient of Sauget Area 2 Site R, thereby reducing mass loading to the Mississippi River. Reduction of mass loading will abate aquatic organism exposure to impacted groundwater, contamination of ecosystems and sediment toxicity. The preferred alternative will, in the short term, prevent or abate actual or potential human and ecosystem exposure to hazardous substances, pollutants and contaminants. In the long term, operation of an engineered barrier may achieve acceptable chemical-specific contaminant levels downgradient of the barrier. Due to the limited scope of the interim action, EPA will be invoking an interim action waiver of chemical-specific ARARs. Chemical-specific ARARs define acceptable concentrations and are used to establish preliminary remediation goals. Aquifer restoration, which will be evaluated in the Sauget Area 2 RI/FS, is not within the scope of the interim remedial action.

12. STATUTORY DETERMINATIONS

Based on information currently available, EPA believes the Preferred Alternative meets the threshold criteria and provides the best balance for tradeoffs among the other alternatives with respect to the balancing and modifying criteria. The EPA expects the Preferred Alternative to satisfy the following statutory requirements of CERCLA Section 121(b): (1) be protective of human health and the environment; (2) comply with ARARs (or justify a waiver); and (3) be cost-effective. Although this interim action is not intended to address fully the statutory mandate for permanence and treatment to the maximum extent practicable, this interim action does utilize treatment and thus supports the statutory mandate. Because this action does not constitute the final remedy for the Sauget Area 2 Groundwater Operable Unit, the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element, although partially addressed in this remedy, will be addressed by the final response action.

12.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The Selected Remedy will protect the Mississippi River from adverse ecological impacts resulting from impacted groundwater being released to surface water. Protection will be achieved by capturing impacted groundwater that results in surface water and sediment toxicity and fish tissue bioaccumulation. Performance of groundwater quality, groundwater level, sediment and surface water monitoring will ensure that remedial action objectives are met.

Implementation of institutional controls can reduce and/or control impact on human health by warning the public of the potential risks associated with eating fish caught in the plume release area.

12.2 COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

The Selected Remedy will comply with all federal and any more stringent State ARARs that pertain to the Site.

12.2.1 Chemical-Specific ARARs

Chemical-specific ARARs define acceptable concentrations and are used to establish preliminary remediation goals. State and federal surface water criteria and drinking water standards are appropriate chemical-specific ARARs for ground-water quality. Brief descriptions of the relevance and applicability of chemical-specific ARARs for groundwater are summarized in the following table:

ARAR	Description	Applicability
40 CFR 141.61	MCLs for organic chemicals for drinking water	Relevant and Appropriate
40 CFR 141.62	MCLs for inorganic chemicals for drinking water	Relevant and Appropriate
40 CFR 264.92	Establishes groundwater protection standards for hazardous waste treatment and disposal facilities	Relevant and Appropriate
40 CFR 264.94	Establishes maximum concentration limits. Provides for establishment of alternate limits for groundwater protection	Relevant and Appropriate
40 CFR 264.95	Establishes point of compliance for which groundwater quality standards apply	Relevant and Appropriate
35 IAC 620	Defines classes of groundwater within the State of Illinois	Applicable
35 IAC 620.410	Establishes numeric groundwater quality standards for Class I Potable Groundwater	Applicable
35 IAC 620.250	Provides for establishment of a groundwater management zone to mitigate impairment	Applicable
35 IAC 620 Subpart D	Establishes groundwater quality standards for classes of groundwater. Provides for establishing alternative groundwater quality standards for any chemical constituent in a groundwater management zone	Applicable

This interim action will only address those risks associated with the release of impacted groundwater to surface water identified in the 2001 ecological risk assessment. EPA will continue to collect the necessary data through the RI/FS process in order to develop options for a long-term comprehensive groundwater cleanup for Area 2. Due to the limited scope of the interim action, EPA will be invoking an interim action waiver of chemical-specific ARARs. An interim action waiver is appropriate where a requirement that is an ARAR cannot be met as part of the interim remedy, but will be attained by the final site remedy.

12.2.2 Location-Specific ARARs

Location specific ARARs set restrictions on activities within certain locations such as floodplains or wetlands. A brief description of the relevance and applicability of location-specific ARARs is summarized in the following table:

ARAR	Description	Applicability
40 CFR Part 6 and Appendix A	Requires Federal agencies to evaluate the potential effects of actions to avoid adversely impacting flood plains	Applicable

12.2.3 Action-Specific ARARs

Action-specific ARARs set controls for particular treatment and disposal activities related to the management of hazardous waste. Brief descriptions of the relevance and applicability of action-specific ARARs are summarized in the following table:

ARAR	Description	Applicability
40 CFR 125	Establishes technology-based limits for direct discharge of treatment system effluent	Applicable
40 CFR 402	Controls the direct discharge of pollutants to surface waters through the National Pollutant Discharge Elimination System (NPDES) program	Applicable

ARAR	Description	Applicability
40 CFR 403.5	Specifically prohibits the direct discharge of pollutants to a publicly-owned treatment works without treatment, that interfere with operations, or that contaminate sludge	Applicable
29 CFR 1910.120	Standards for conducting work at hazardous waste sites	Applicable
29 CFR 1926	OSHA safety and health standards	Applicable
35 IAC 306.302	Standards for expansion of existing or establishment of new combined sewer service areas	Relevant and Appropriate
35 IAC 307.1101	Sewer discharge criteria that prohibit entry of certain types of pollutants into a POTW	Applicable
35 IAC 309.102	A NPDES permit is required for any discharge to the waters of the State of Illinois	Applicable
35 IAC 309.202	A State Construction permit is required for new sewer and wastewater sources	Applicable

Appropriate ARARs will depend on the type of treatment process selected and whether the treatment and discharge occur on site or off site. Pursuant to Section 121(e) of CERCLA, "no Federal, State, or local permit shall be required for the portion of any removal or remedial action conducted entirely onsite, where such remedial action is selected and carried out in compliance with this section." Both the treatment process and the onsite/offsite determination will be made during the remedial design and the appropriate ARARs will be applied at that time.

12.3 COST-EFFECTIVENESS

The Selected Remedy is cost-effective and represents a reasonable value for the money to be spent. In making this determination, the following definition was used: "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness" (NCP 300.430(f)(ii)(D)). This determination was made by evaluating the overall effectiveness of those alternatives that satisfy the threshold criteria (i.e., that are protective of human health and the environment and comply with all federal and any more stringent State ARARs, or as appropriate, waive ARARs). Overall effectiveness was evaluated by assessing three of the five balancing criteria-long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness, in combination. The overall effectiveness of each alternative then was compared to the alternative's costs to determine cost-effectiveness. The relationship of the overall effectiveness of this remedial alternative was determined to be proportional to its costs and hence represents a reasonable value for the money to be spent. As only two alternatives were considered to be protective and ARAR compliant, the evaluation of the most cost-effective alternative was based upon a comparison of the costs between Alternative 2 (with a net present value of $26.5 million) and Alternative 3 (with a net present value of $50.3 million). Alternative 2 is the most cost effective of the alternatives evaluated.

12.4 UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT (OR RESOURCE RECOVERY) TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE

Of those alternatives that are protective of human health and the environment and comply with ARARs, EPA has determined that the Selected Remedy provides the best balance of trade-offs in terms of the five balancing criteria, while also considering the statutory preference for treatment as a principal element and bias against off-site treatment and disposal and considering state and community acceptance. A principal element of the Remedy is the extraction and treatment of contaminated groundwater. The Selected Remedy does utilize treatment and thus supports the statutory mandate. The Selected Remedy satisfies the criteria for long-term effectiveness by preventing groundwater with contaminants in excess of allowable concentrations from being released to the Mississippi River. The barrier wall and extraction wells, along with monitoring and institutional controls, will provide more long-term effectiveness and permanence than the other alternatives. The Selected Remedy reduces the mobility of groundwater contaminants by providing physical and hydraulic control and removal of affected groundwater before it releases to the Mississippi River. The

Selected Remedy does not present short-term risks different from the other alternatives. The Selected Remedy is likely to be more difficult to implement than the other alternatives evaluated, however, installation of a physical barrier and a three-well groundwater extraction system can be accomplished with conventional materials and equipment. In addition, IEPA is supportive of Alternative 2, and the community showed no preference between Alternatives 2 and 3. Since the Selected Remedy is an interim action, it is not intended to address fully the statutory mandate for permanence and treatment to the maximum extent practicable.

12.5 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

One of the principal elements of the Selected Remedy is the extraction and treatment of contaminated groundwater. Therefore, the Selected Remedy satisfies the statutory preference for treatment as a principal element by reducing mass loading to the Mississippi River through extraction and treatment of contaminated groundwater. The statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element, although partially addressed in this remedy, will be more fully addressed by the final response action.

12.6 FIVE-YEAR REVIEW REQUIREMENTS

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

12.7 DOCUMENTATION OF NO SIGNIFICANT CHANGES

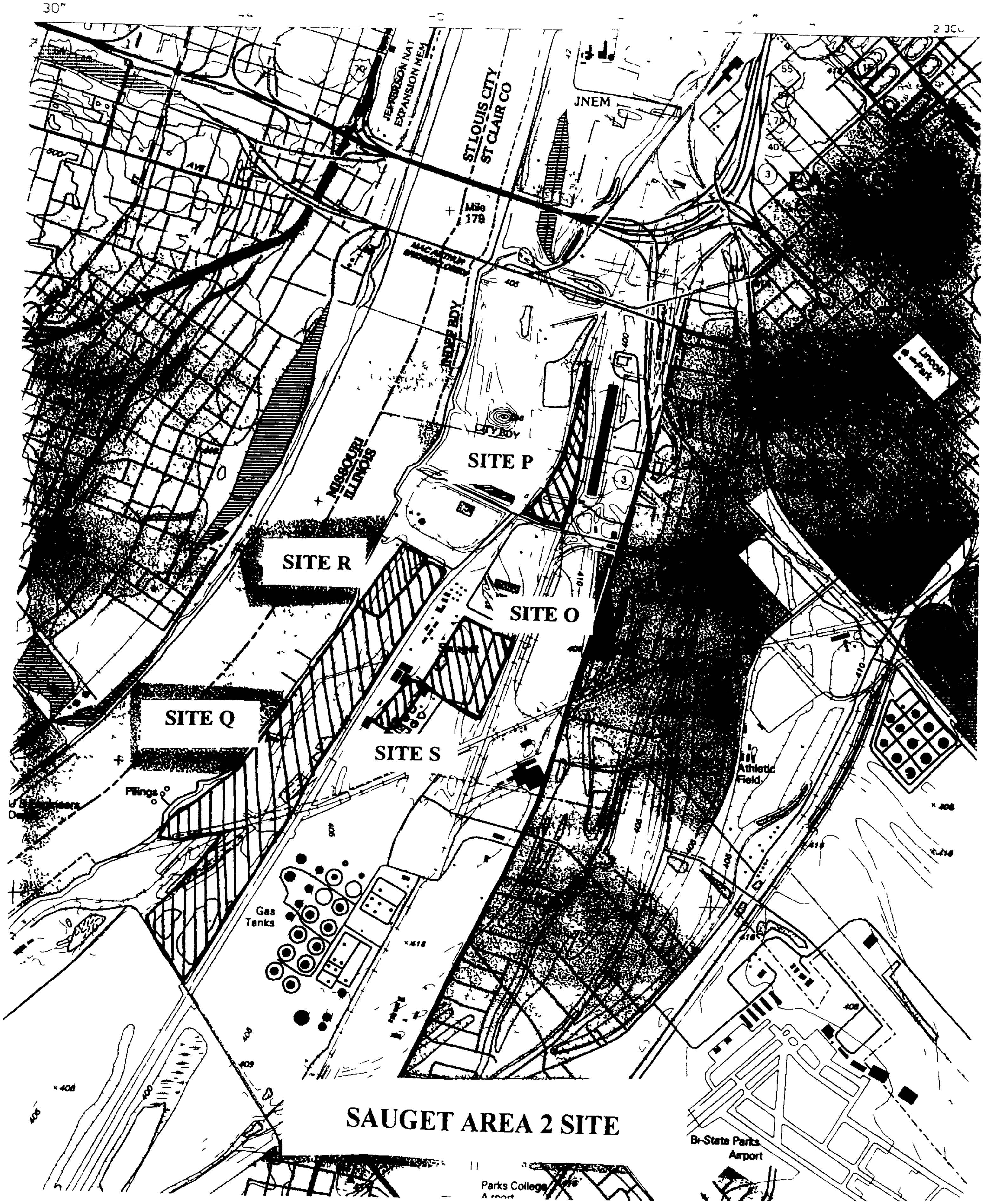
The Proposed Plan was released for public comment in June 2002. It identified Alternative 2, engineered barrier and groundwater extraction as the Preferred Alternative to address the release of contaminated groundwater to the Mississippi River in the vicinity of Sauget Area 2 Site R. EPA reviewed all written and verbal comments submitted during the public comment period. It was determined that no changes to the remedy, as originally identified in the Proposed Plan, were necessary.

The Proposed Plan stated that extracted groundwater would be routed to the ABRTF via subsurface pipeline which would connect with the Village of Sauget trunk sewer leading to the PChem Plant. The ROD does not specify a treatment option for the extracted groundwater. Several groundwater treatment options are being evaluated including the ABRTF. Selection of the actual treatment technologies and the location of the treatment system will be determined during the remedial design.

FIGURES

Figure 1-1

Sauget Area 2 Site Location Map



JEFFERSON NAT EXPANSION MEM
ST LOUIS CITY
ST CLAIR CO
JNEM
Mile 179
MAC ARTHUR BRIDGE
INDEP BDY
MISSOURI
ILLINOIS
CITY BDY
SITE P
SITE R
SITE O
SITE Q
SITE S
Pilings
Gas Tanks
Athletic Field
Lincoln Park
SAUGET AREA 2 SITE
Bi-State Parks Airport
Parks College

Figure 5-1

Conceptual Site Model for Human Health Risk Assessment

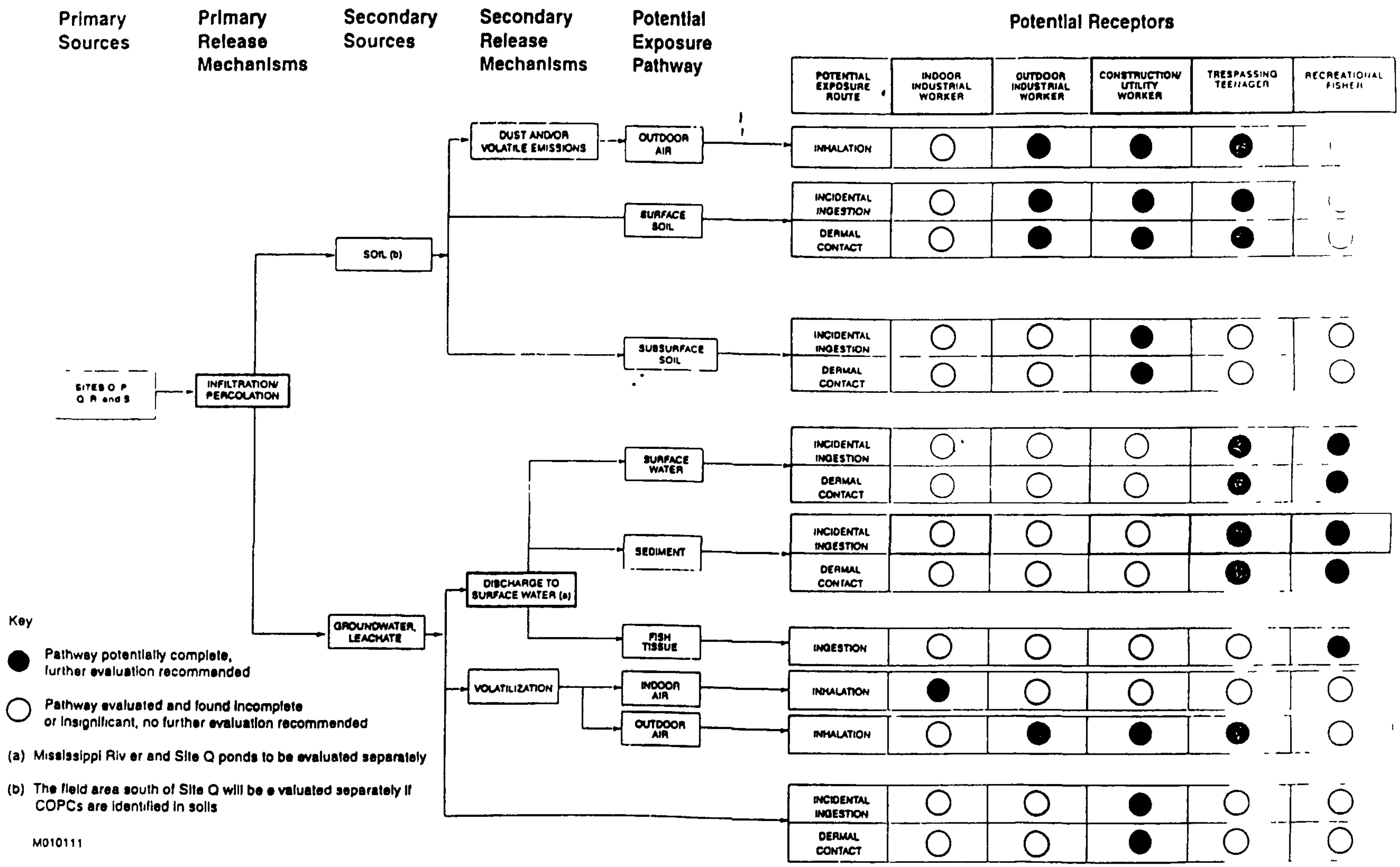


FIGURE
Conceptual Site Model for Human Health Risk Assessment
Sauget Area 2 RI/FS SSP
Sauget Area 2 Sites Group

Figure 5-2

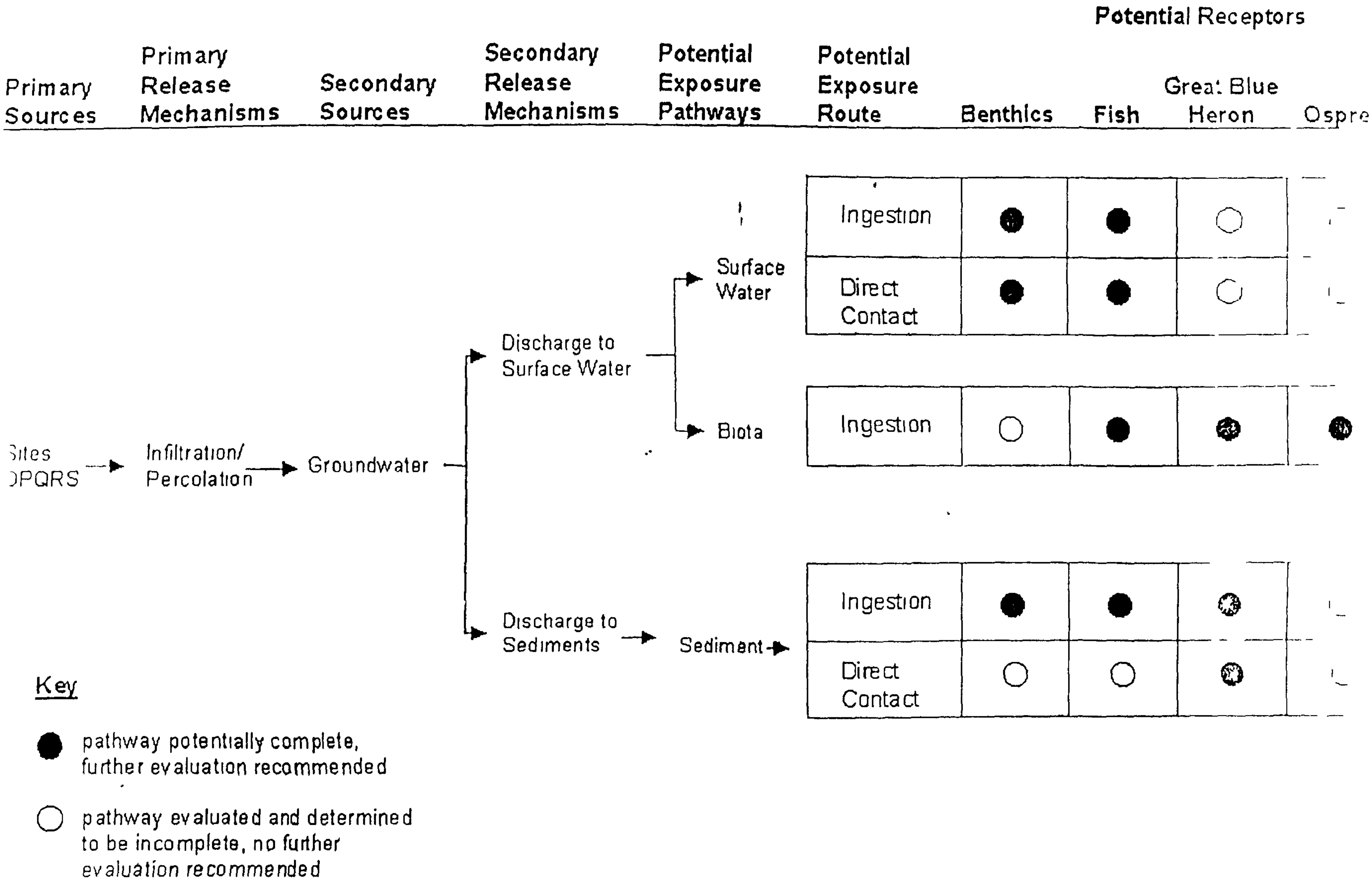
Aquatic Conceptual Site Model for the Ecological Risk Assessment

Figure 12-2

Aquatic Conceptual Site Model

for the Ponded Area

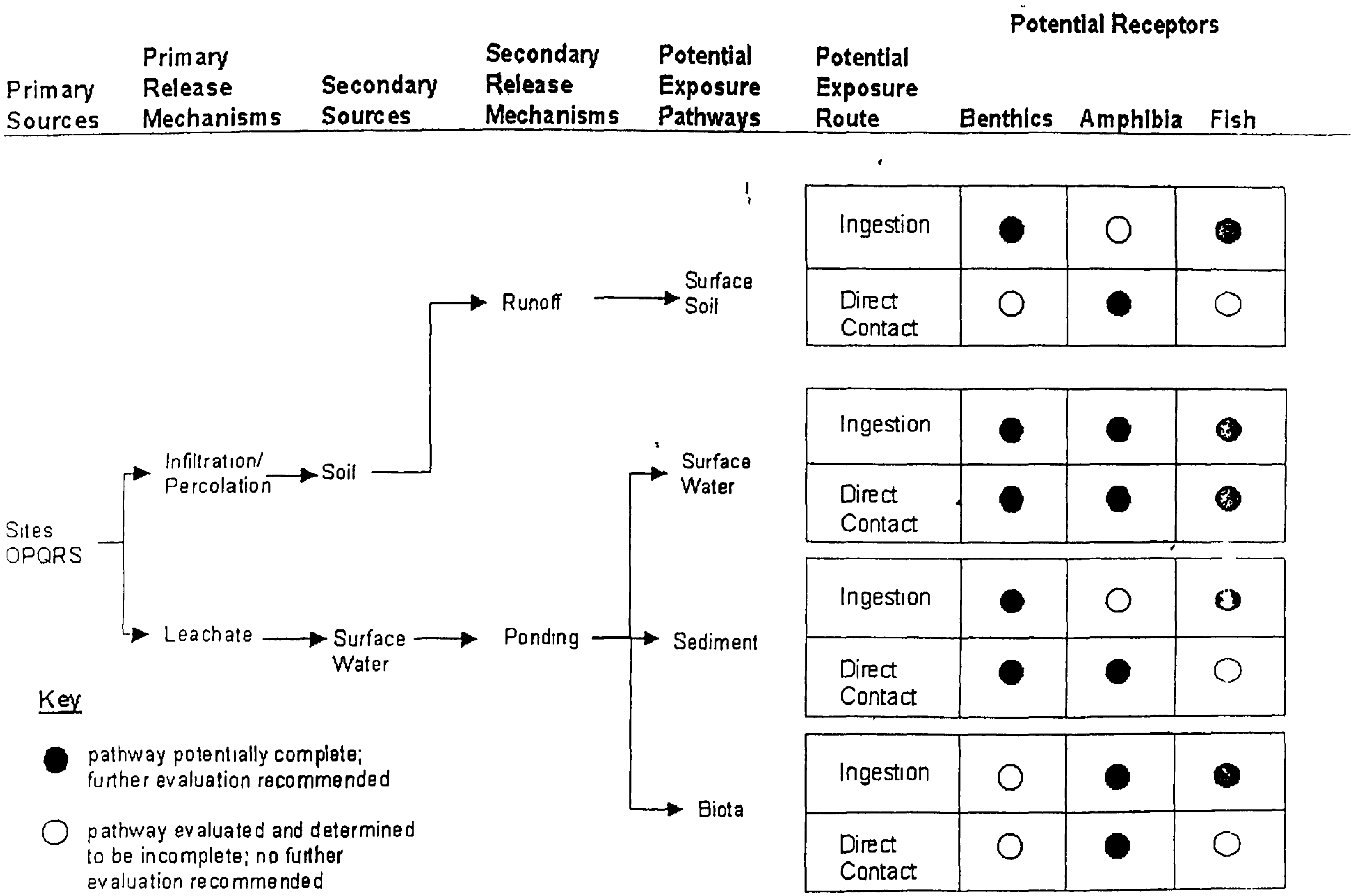
Ecological Risk Assessment



Aquatic Conceptual Site Model for the Mississippi River Ecological Risk Assessment
Sauget Area 2 RI/FS SSP
Sauget Area 2 Sites Group

Figure 5-3

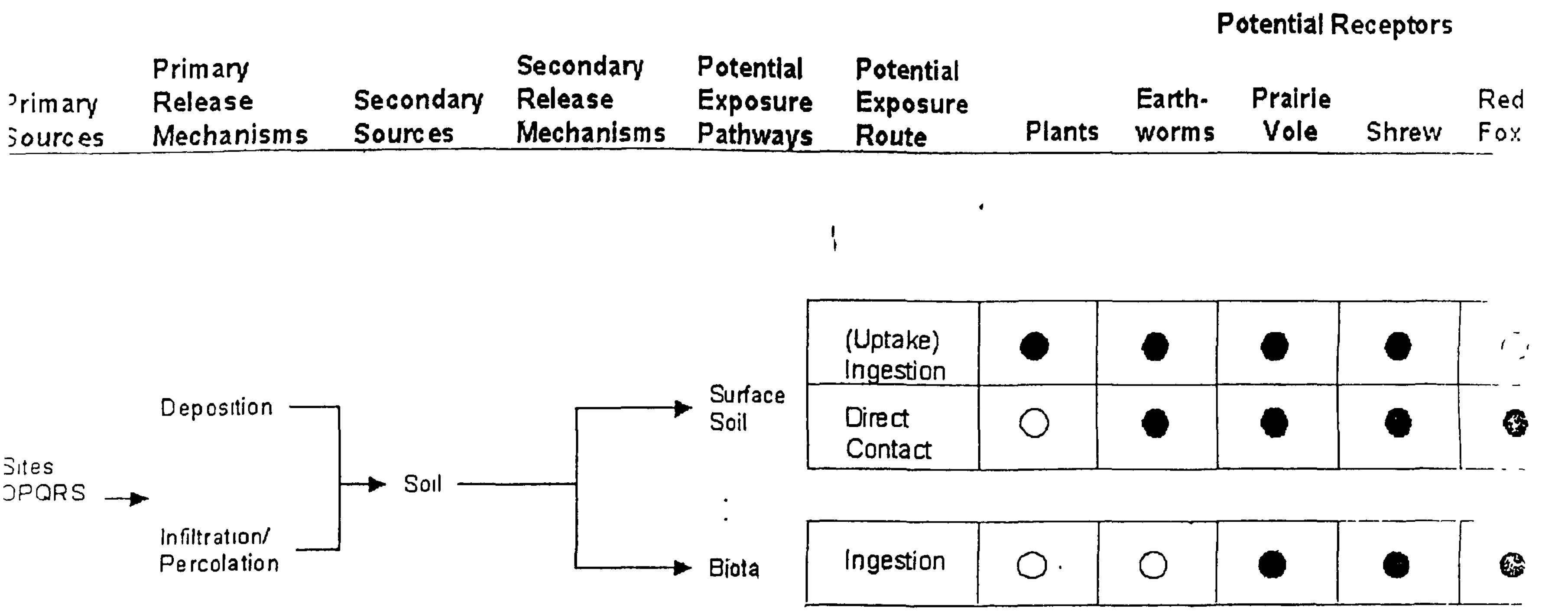
Aquatic Conceptual Site Model for the Ecological Risk Assessment



Aquatic Conceptual Site Model for the Ponded Area Ecological Risk Assessment
Sauget Area 2 RI/FS SSP
Sauget Area 2 Sites Group

Figure 5-4

Terrestrial Conceptual Site Model for the Ecological Risk Assessment



Key

● pathway potentially complete; further evaluation recommended

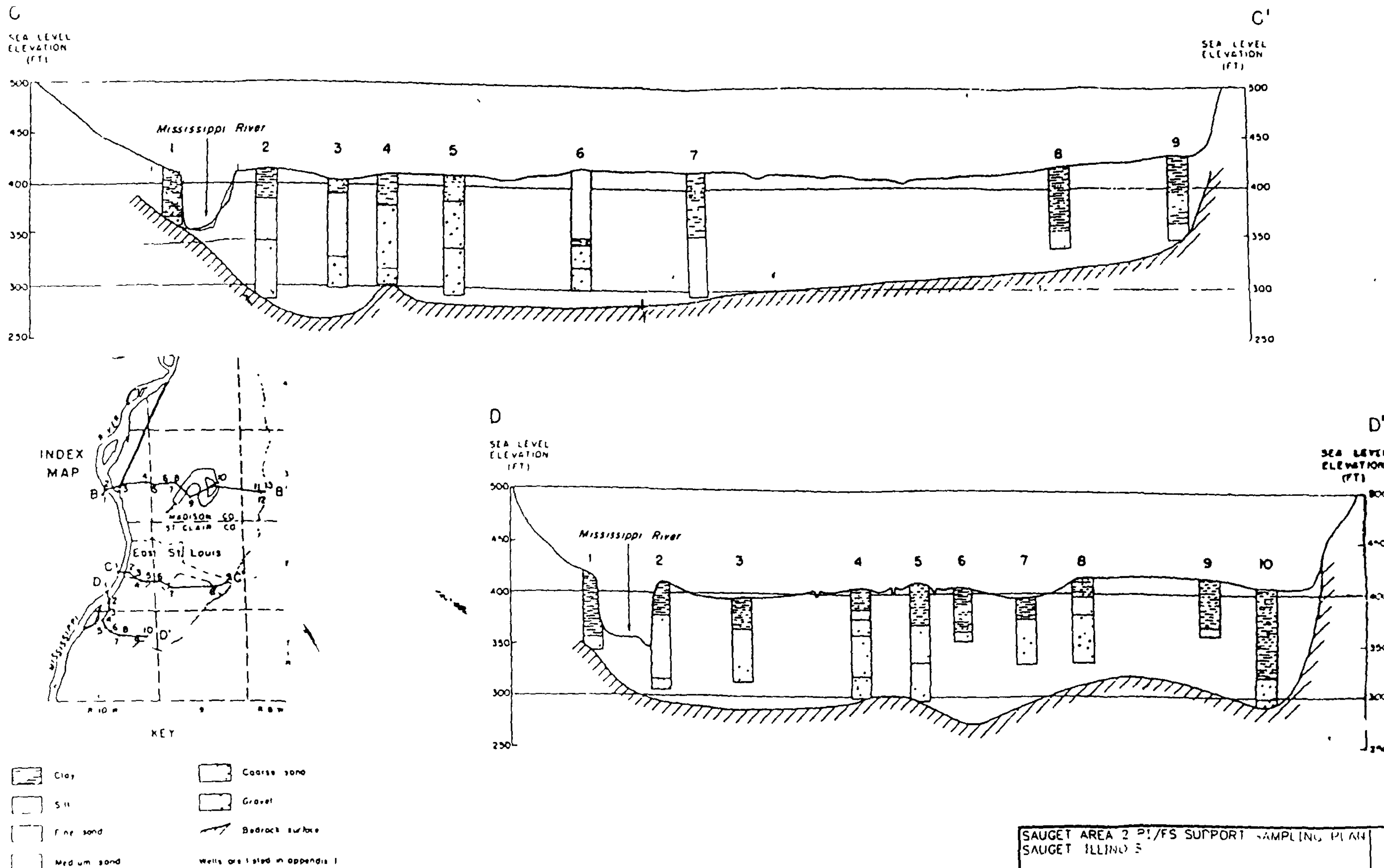
○ pathway evaluated and determined to be incomplete; no further evaluation recommended

Terrestrial Conceptual Site Model for Ecological Risk Assessment
Sauget Area 2 RI/FS SSP
Sauget Area 2 Sites Group

Figure 5-5

Cross Sections of the Valley Fill

East St. Louis Area, Illinois



HORIZONTAL SCALE 0 1 MILE

TAKEN FROM THE GROUNDWATER GEOLOGY OF THE EAST ST LOUIS AREA ILLINOIS REPORT PREPARED BY ILLINOIS STATE GEOLOGICAL SURVEY

SAUGET AREA 2 RI/FS SUPPORT SAMPLING PLAN
SAUGET ILLINOIS

URS

DRN BY djd 5/4/0
DSGN BY ss
CHKD BY

Cross Sections of the ... the East St Louis ...

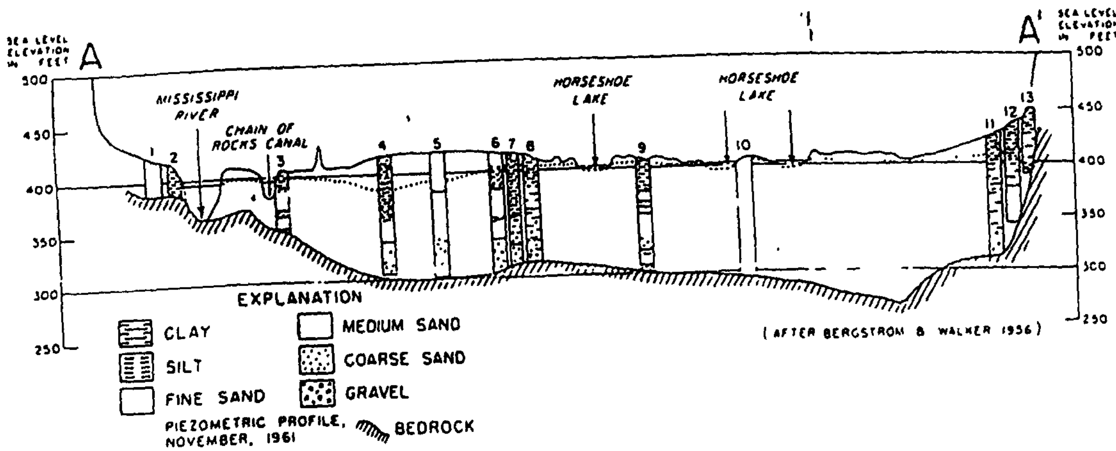
Figure 5-6

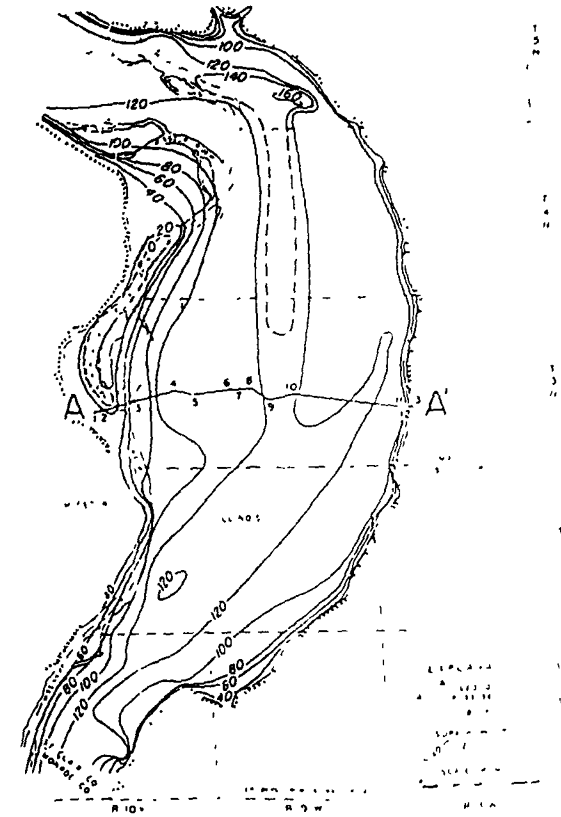
Geologic Cross Section

and

Piezomètric Profile of the Valley Fill

J10024 GOV PASTE AND CUT DWG Last edited 05/04/01





SAUGET ARE 2 R /FS SUPPORT SAMPLING
SAUGET ILLINOIS

URS

DRN BY djd
DSGN BY ss
CHKD BY

Geologic Cr
Piezometric

REFERENCE TAKEN FROM A PAPER BY JOSEPH D RITCHEY AND RICHARD J SCHICHT ENTITLED GROUND-WATER MANAGEMENT IN THE AMERICAN BOTTOMS ILLINOIS

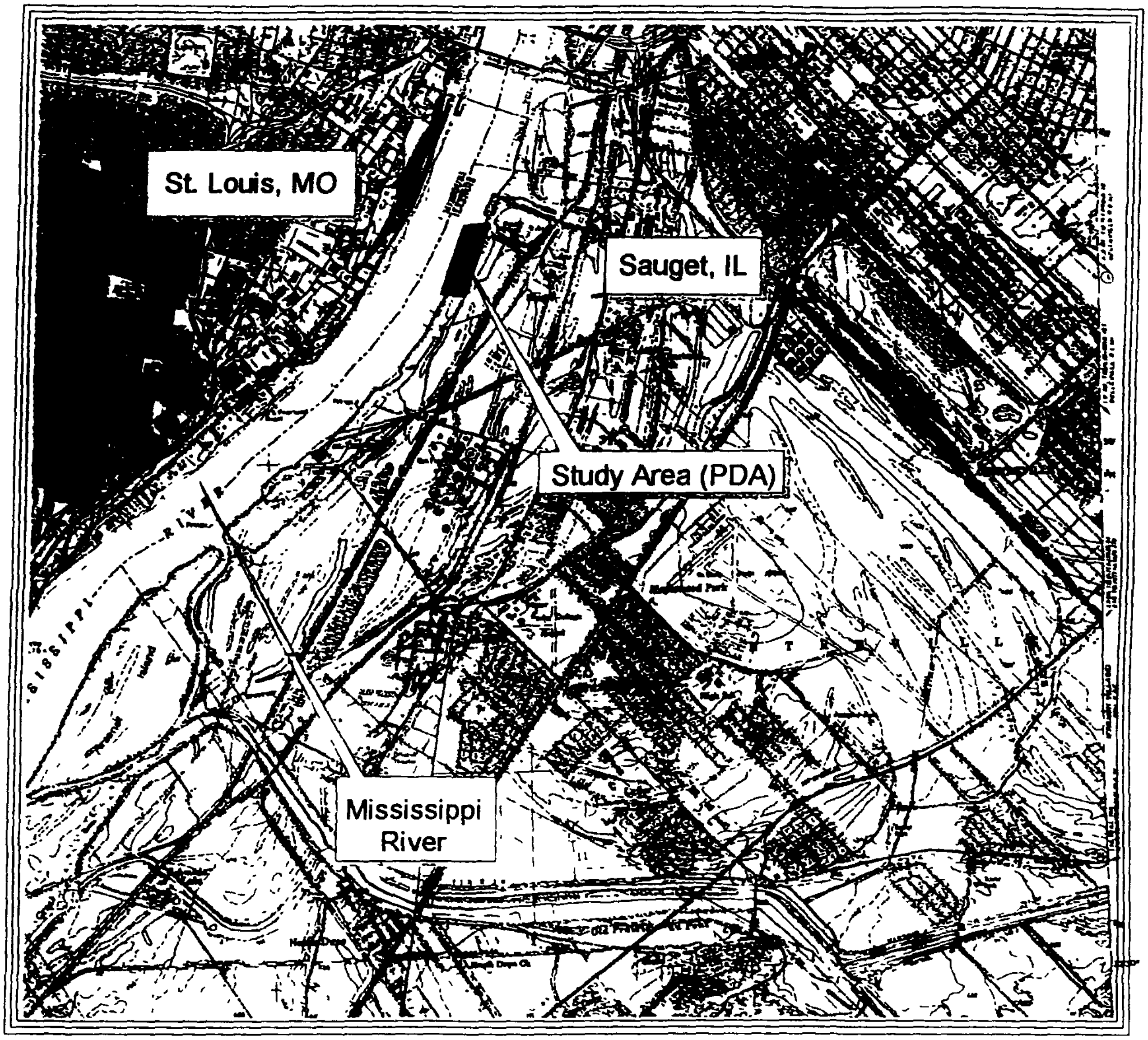
Figure 5-7

Site Locus (PDA)

W.G. Krummrich Plant

Ecological Risk Assessment

Figure - Site Locus (PDA)
WGK Plant Ecological Risk Assessment
Sauget, IL



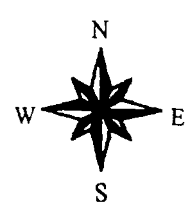
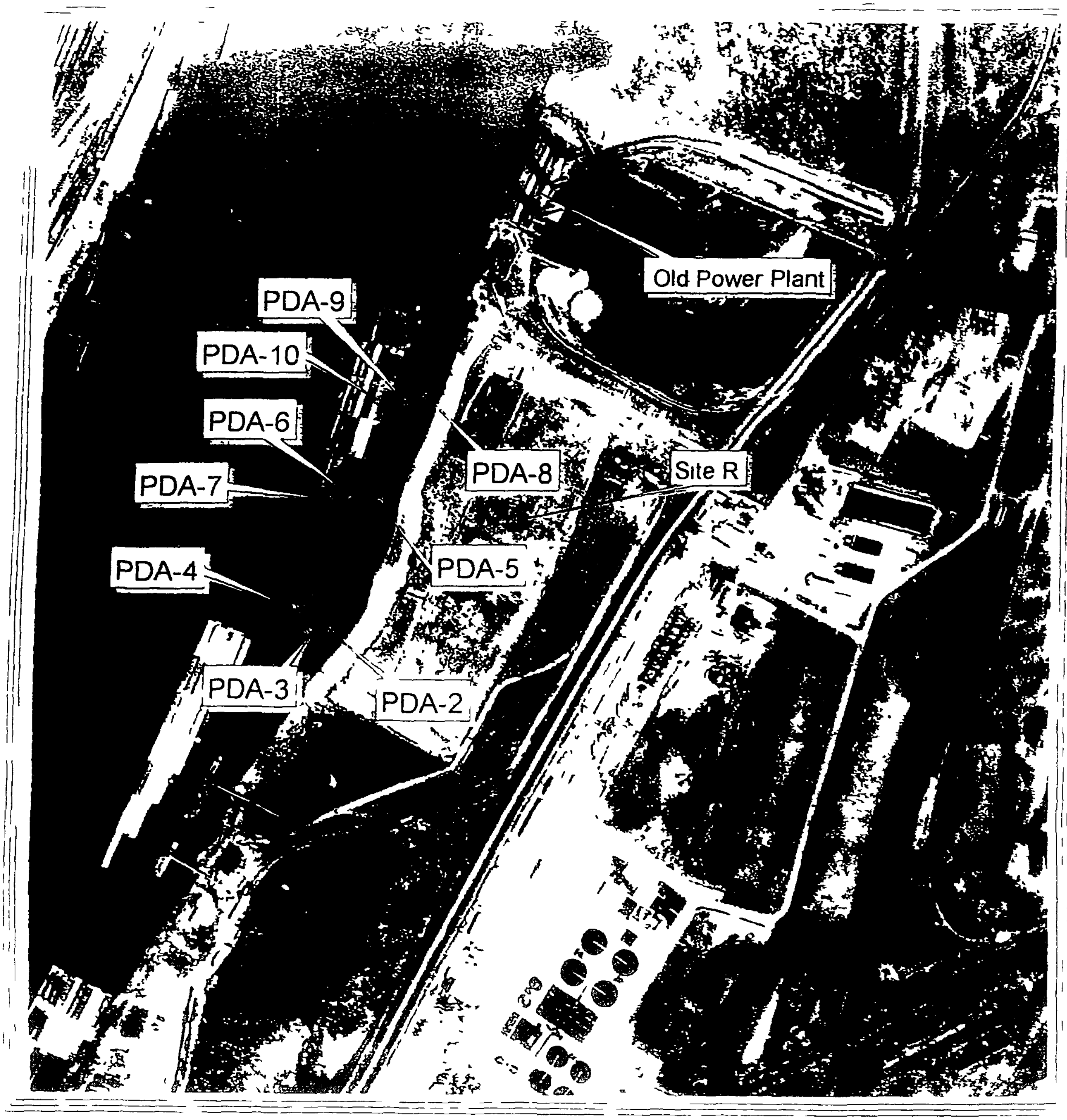


Figure 5-8

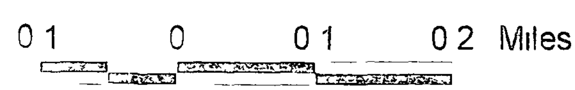
PDA Transect Layout

W.G. Krummrich Plant

Ecological Risk Assessment



NOTE
North Stations = PDA10, PDA9 PDA8
Middle Stations = PDA7, PDA6, PDA5
South Stations (South of Dike) = PDA4, PDA3, PDA2



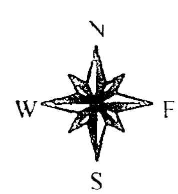


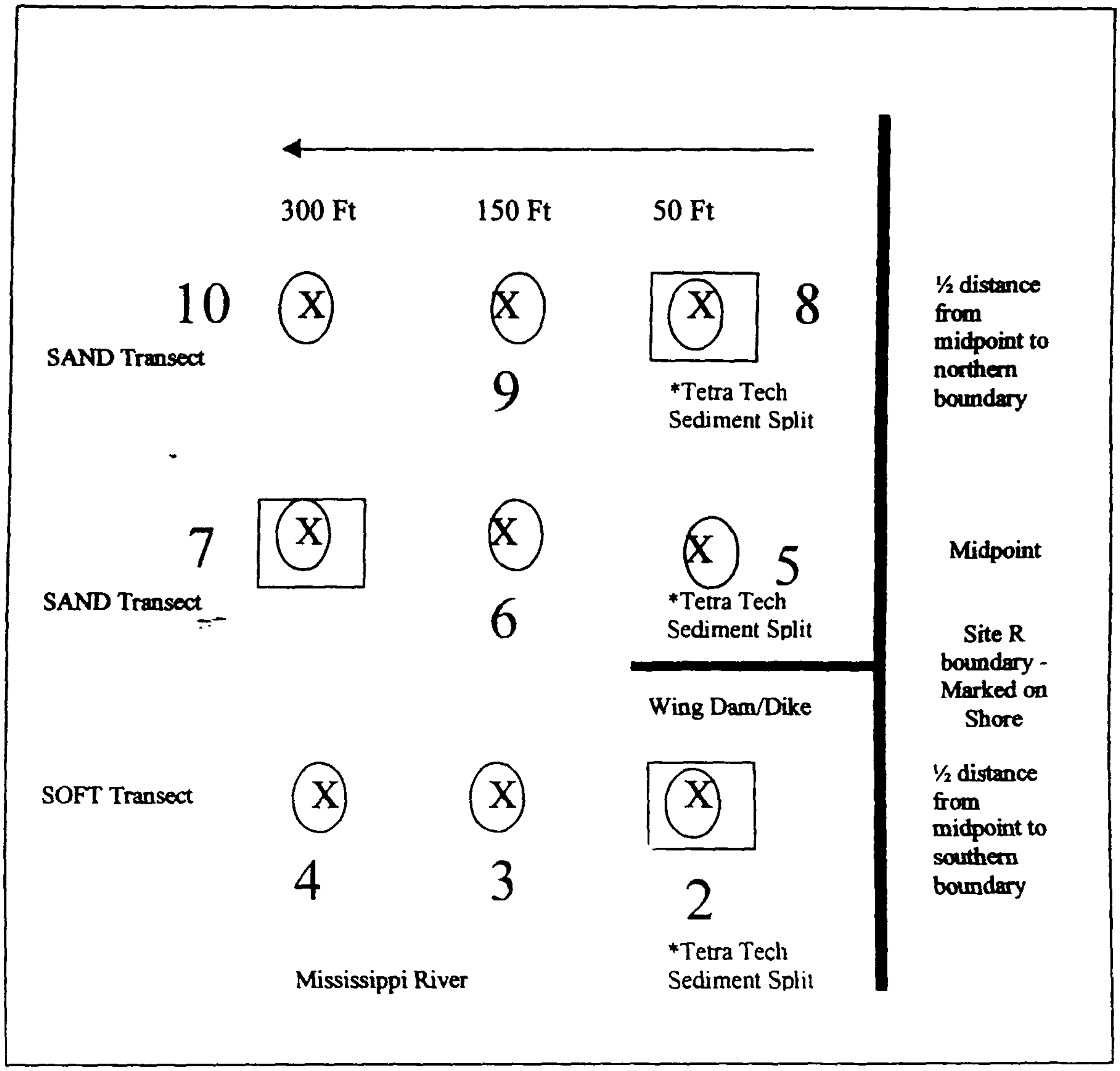
Figure 5-9

PDA Transect Layout (Schematic)

W.G. Krummrich Plant

Ecological Risk Assessment

FIGURE ˋ· : PDA Transect Layout (Schematic)
WGK Plant Ecological Risk Assessment
Sauget, Illinois



X Sediment Collection and Sediment Bioassay

○ Water and bioassays at bottom only

□ Benthic Community

Reference Numbers:
UDA-Sand = 11
UDA – Soft = 12
DDA – Sand = 13
DDA – Soft = 1

North

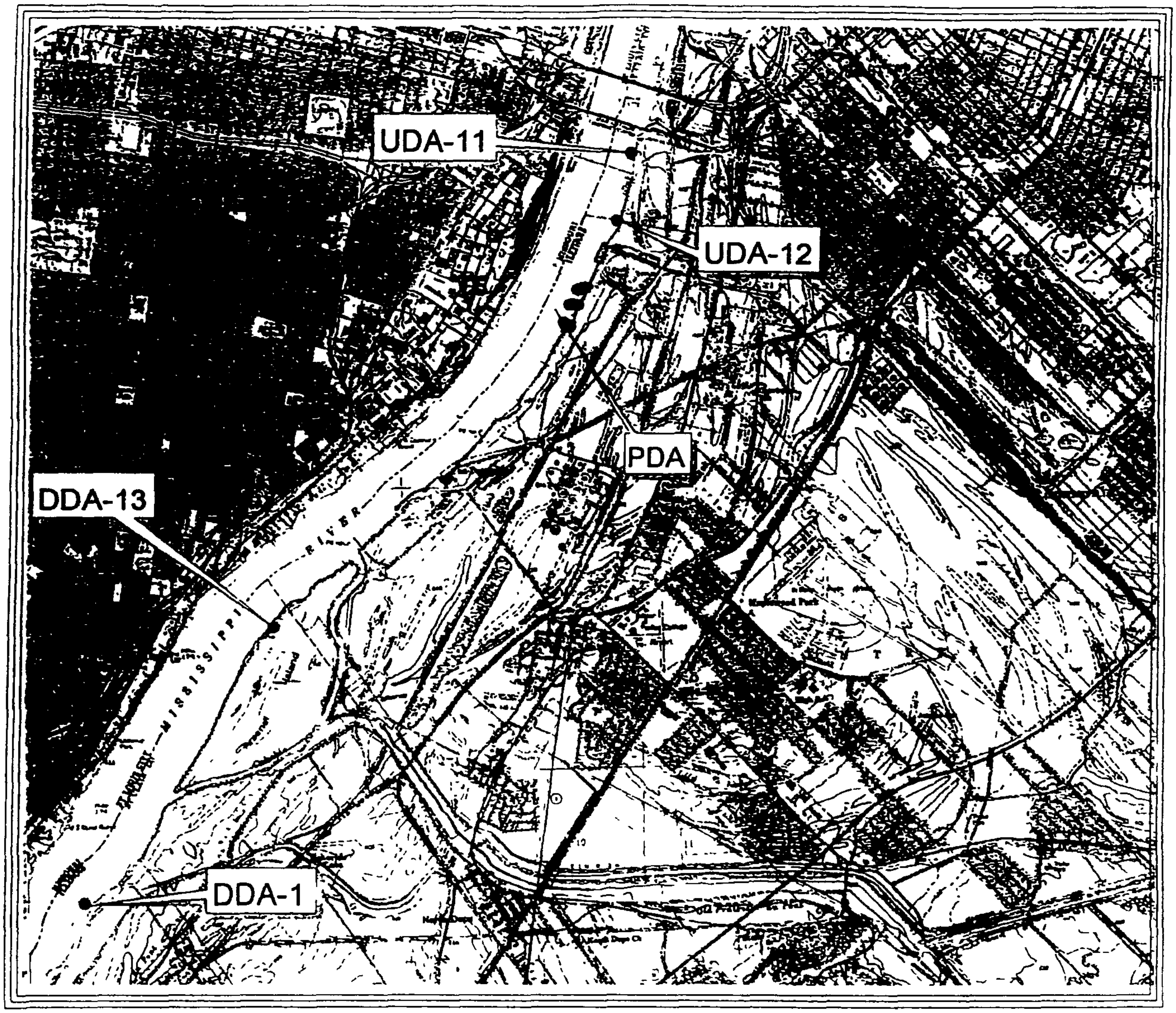
Figure 5-10

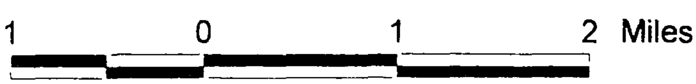
PDA, UDA and DDA Locus Map

W.G. Krummrich Plant

Ecological Risk Assessment

Figure PDA, UDA and DDA Locus Map
WGK Plant Ecological Risk Assessment
Sauget, Illinois





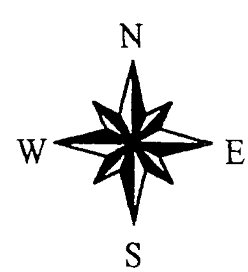


Figure 5-11

EPA Sediment Sampling Locations

Adjacent to Site R

TETRA TECH SAMPLING LOCATION

MENZIE-CURA SAMPLING LOCATION

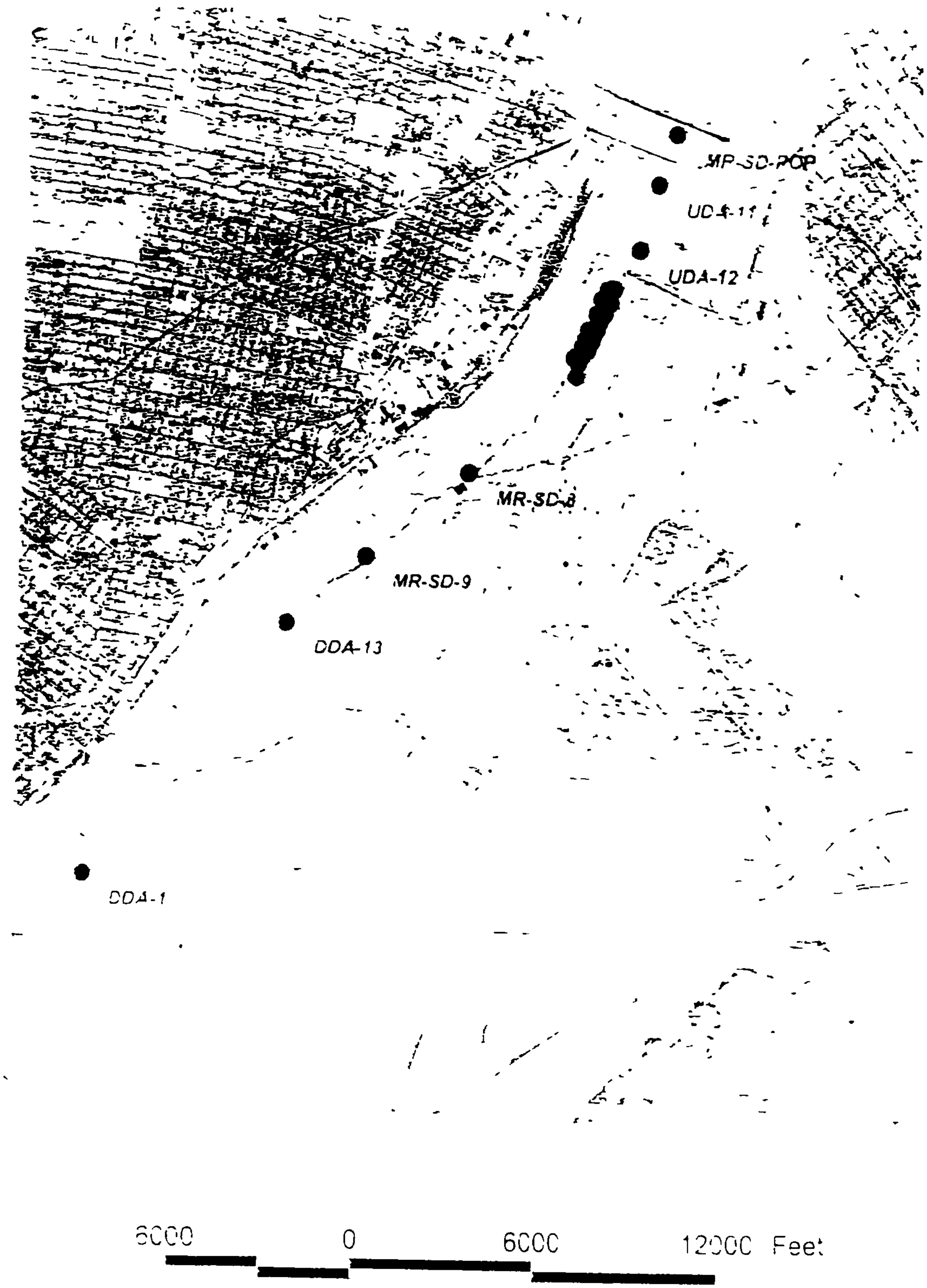
SOLUTIA FACILITY SAUGET ILLINOIS
SAMPLING LOCATIONS
ADJACENT TO SITE R

TETRA TECH EM INC

Figure 5-12

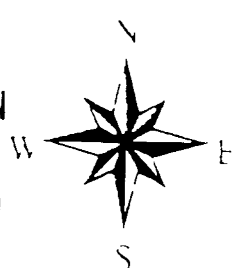
EPA Upstream and Downstream

Sediment Sampling Locations



• TETRA TECH SAMPLING LOCATION

• MENZIE-CURA SAMPLING LOCATION



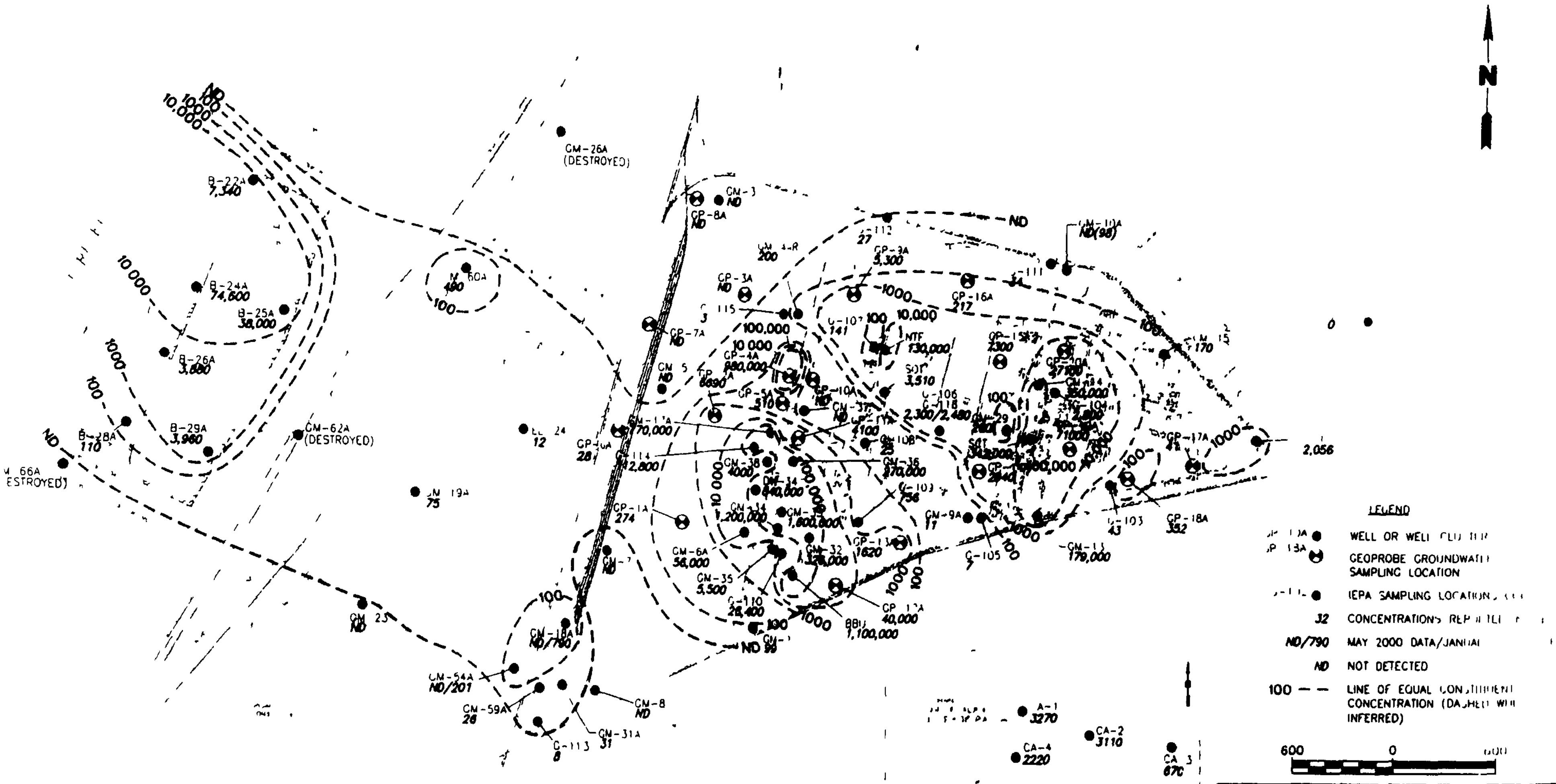
SOLUTIA FACILITY SAUGET, ILLINOIS
UPSTREAM AND DOWNSTREAM
SAMPLING LOCATIONS

TETRA TECH EM INC

Figure 5-13

Total VOC Concentrations

Shallow Hydrogeologic Unit



Title:

TOTAL VOC CONCENTRATIONS SHALLOW HYDROGEOLOGIC UNIT

W G KRUMMRICH PLANT
SAUGET ILLINOIS

Prepared For:

SOLUTIA INC

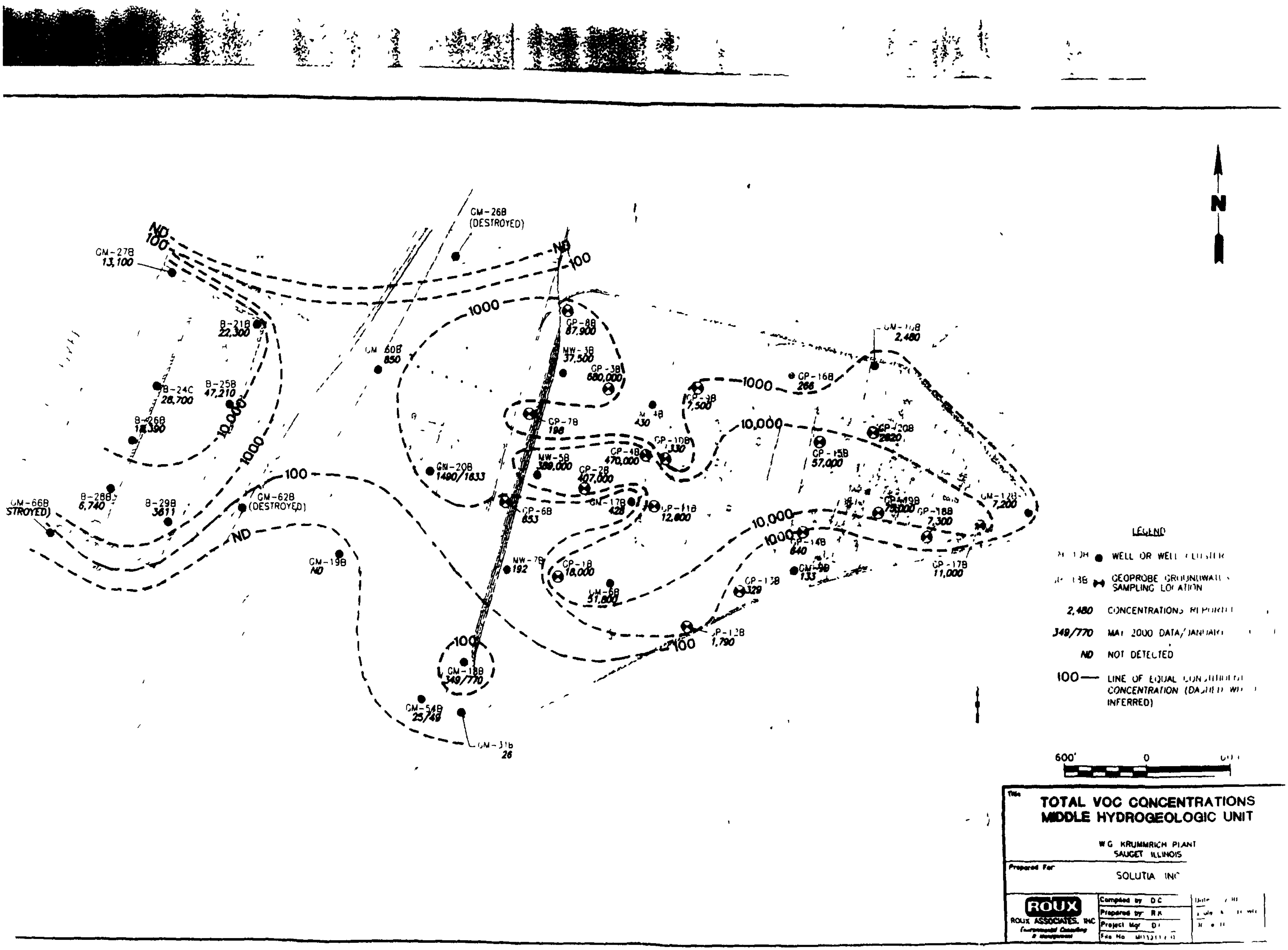
ROUX
ROUX ASSOCIATES, INC
Environmental Consulting & Management

Compiled by: DC	Date:		
Prepared by: RK	Scale:		
Project Mgr: DC			
File No:			

Figure 5-14

Total VOC Concentrations

Middle Hydrogeologic Unit

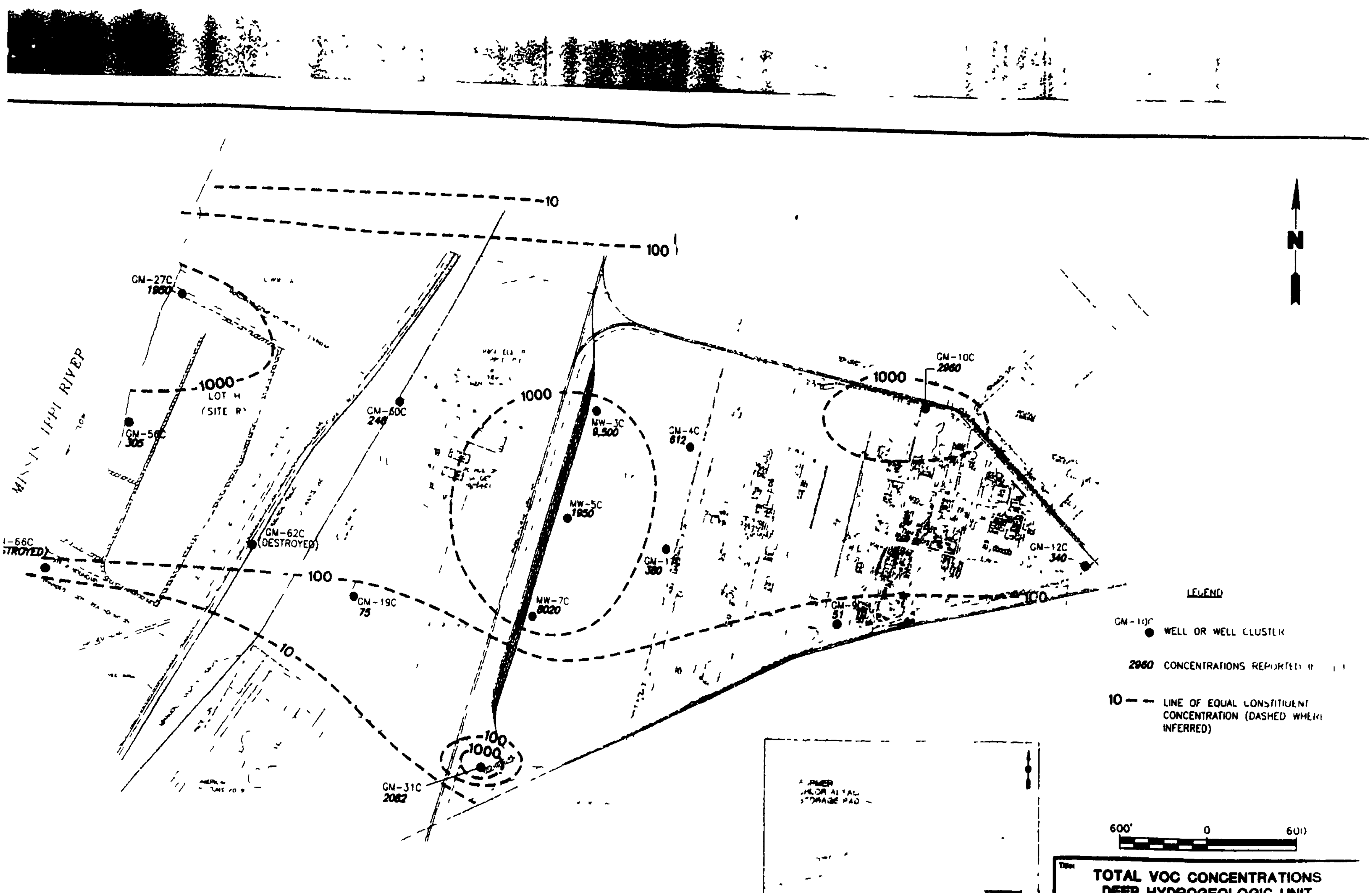


TOTAL VOC CONCENTRATIONS
MIDDLE HYDROGEOLOGIC UNIT
W.G. KRUMMRICH PLANT
SAUGET, ILLINOIS
Prepared For
SOLUTIA INC
ROUX
ROUX ASSOCIATES, INC
Compiled by D.C.
Prepared by R.K.
LEGEND
WELL OR WELL CLUSTER
GEOPROBE GROUNDWATER SAMPLING LOCATION
2,480 CONCENTRATIONS REPORTED
349/770 MAY 2000 DATA/JANUARY
ND NOT DETECTED
100 LINE OF EQUAL CONSTITUENT CONCENTRATION (DASHED WHERE INFERRED)
600' 0
N
GM-27B 13,100
GM-26B (DESTROYED)
B-21B 22,300
B-24C 28,700
B-25B 47,210
B-26B
B-28B 6,740
B-29B 3611
GM-62B (DESTROYED)
GM-66B (DESTROYED)
GM-19B ND
GM-60B 850
GM-20B 1490/1633
GP-8B 87,900
MW-3B 37,500
GP-3B 680,000
GP-7B 198
MW-5B 389,000
GP-2B 407,000
GP-4B 470,000
GP-6B 853
GM-17B 428
GP-11B 12,800
GP-9B 7,500
GP-16B 266
GP-15B 57,000
GP-20B 2820
GP-19B 73,000
GP-18B 7,300
GM-12B 7,200
GP-17B 11,000
GP-14B 640
GP-13B 329
GP-12B 1,790
GP-1B 18,000
GM-6B 51,800
MW-7B 192
GM-18B 349/770
GM-54B 25/49
2,480
133
ND
100
1000
10,000

Figure 5-15

Total VOC Concentrations

Deep Hydrogeologic Unit



TOTAL VOC CONCENTRATIONS DEEP HYDROGEOLOGIC UNIT

W.G. KRUMMRICH PLANT
SAUGET, ILLINOIS

Prepared For:
SOLUTIA, INC

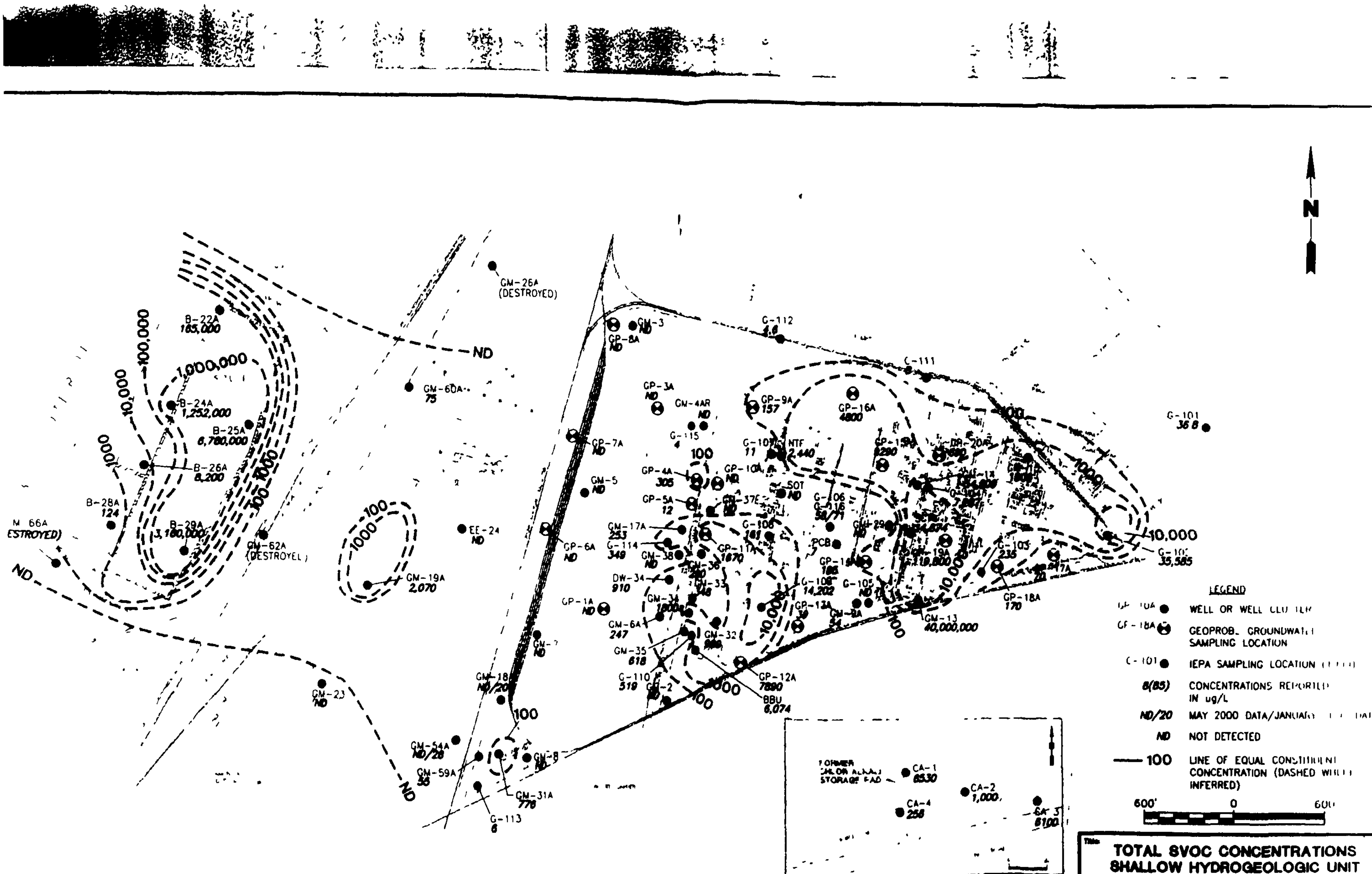
ROUX ASSOCIATES, INC
Environmental Consulting & Management

Compiled by: D.C.	Date:	
Prepared by: R.K.	Scale: AS SHOWN	
Project Mgr: D.C.	Office: NY	
File No: M03911209		

Figure 5-16

Total SVOC Concentrations

Shallow Hydrogeologic Unit



LEGEND

- WELL OR WELL CLUSTER
- GEOPROBE GROUNDWATER SAMPLING LOCATION
- IEPA SAMPLING LOCATION
- 8(85) CONCENTRATIONS REPORTED IN ug/L
- ND/20 MAY 2000 DATA/JANUARY DATA
- ND NOT DETECTED
- 100 LINE OF EQUAL CONSTITUENT CONCENTRATION (DASHED WHERE INFERRED)

600' 0 600'

TOTAL SVOC CONCENTRATIONS SHALLOW HYDROGEOLOGIC UNIT

W G KRUMMRICH PLANT
SAUGET, ILLINOIS

Prepared For
SOLUTIA, INC

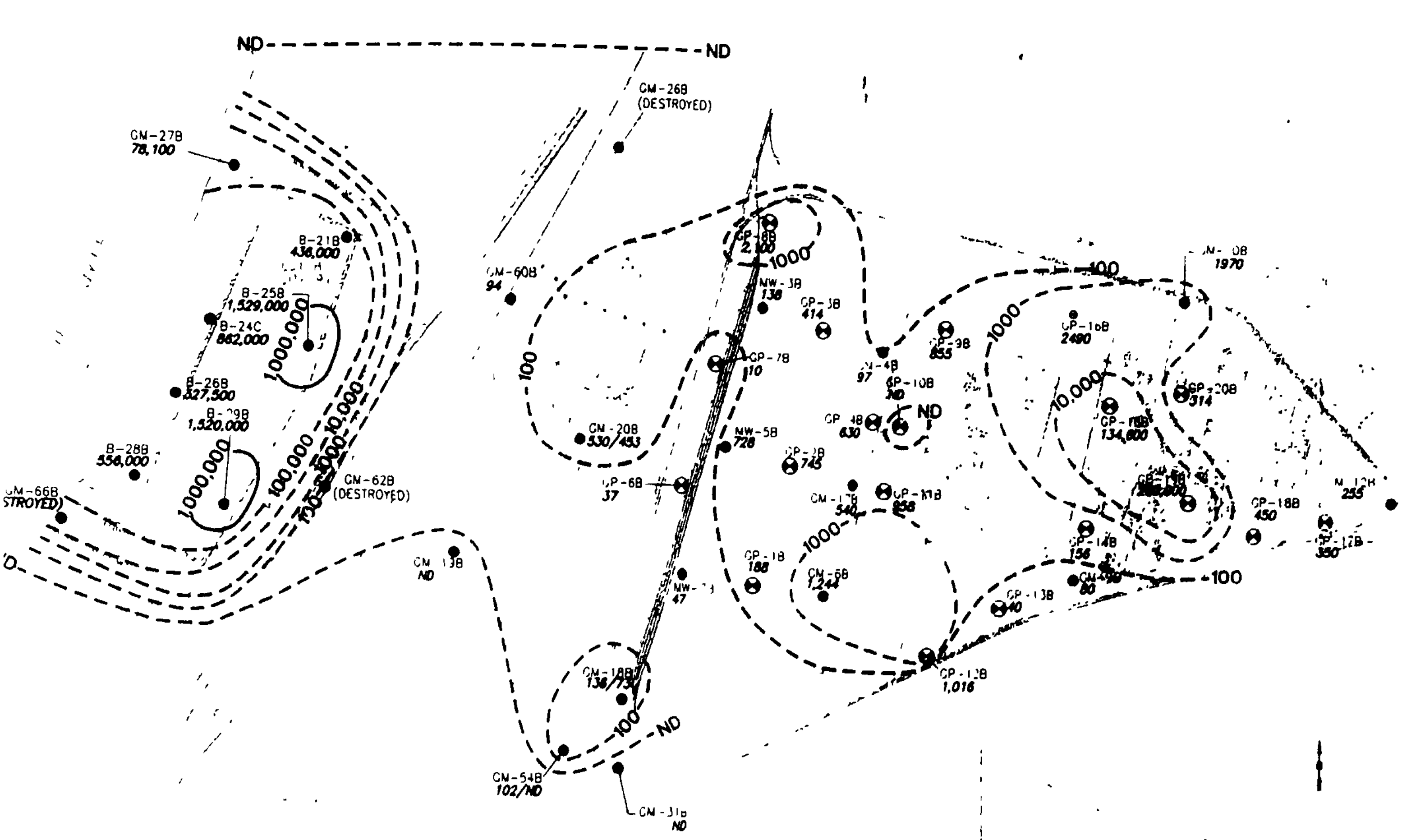
ROUX ASSOCIATES, INC.

Compiled by D.C.	Date
Prepared by R.K.	Scale AS SHOWN
Project Mgr D.C.	Office NY
File No M03811906	Project

Figure 5-17

Total SVOC Concentrations

Middle Hydrogeologic Unit



LEGEND

WELL OR WELL POINT

GEOPROBE GROUNDWATER SAMPLING LOCATION

2,480 CONCENTRATION

145/73 MAY 2000 DATA/JANUARY

ND NOT DETECTED

100 - - LINE OF EQUAL CONCENTRATION CONCENTRATION (DASHED WHERE INFERRED)

600' 0

Title

TOTAL SVOC CONCENTRATIONS MIDDLE HYDROGEOLOGIC UNITS

W.G. KRUMMRICH PLANT
SAUGET ILLINOIS

Prepared For

SOLUTIA INC

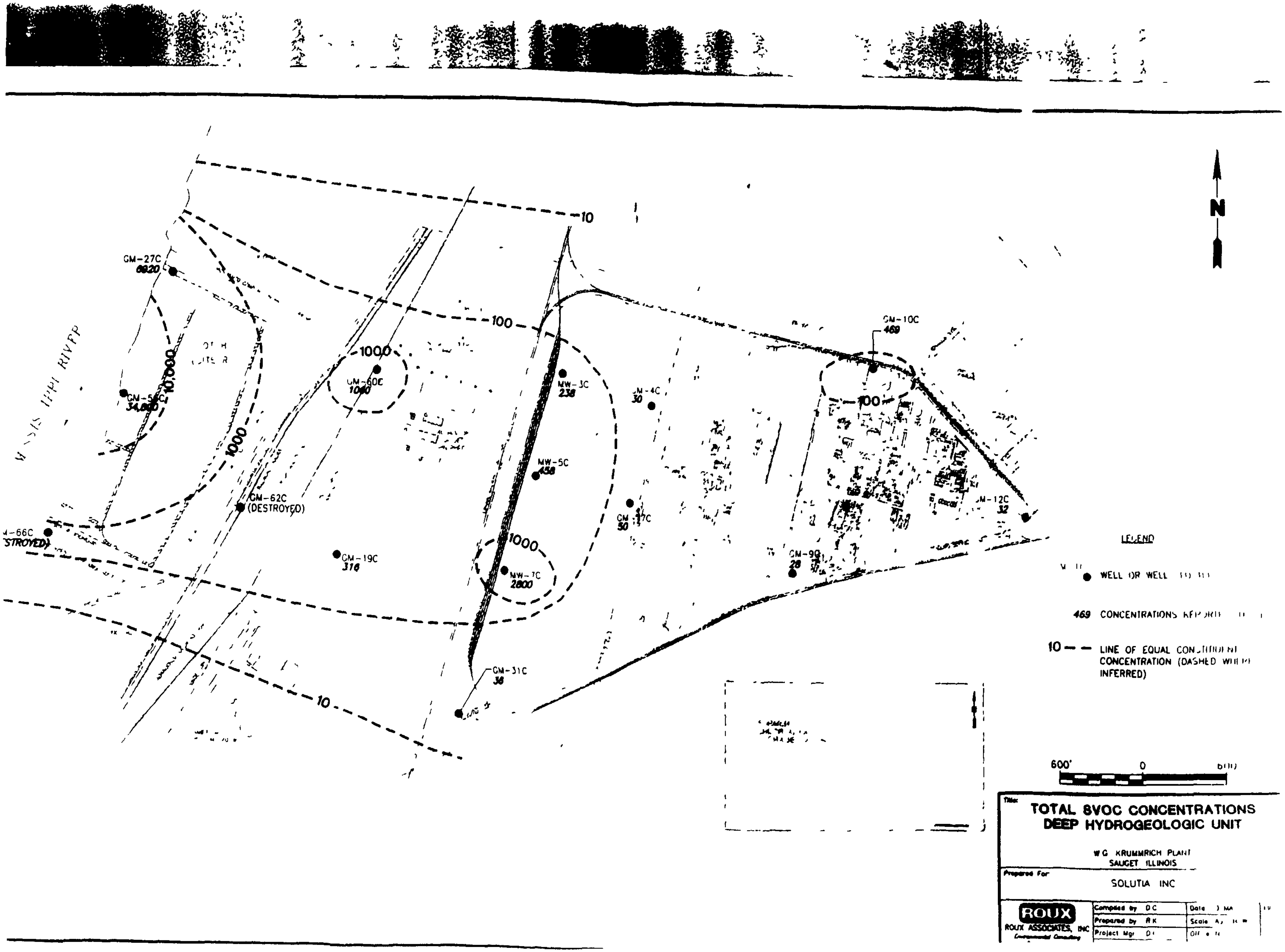
ROUX
ROUX ASSOCIATES, INC
Environmental Consulting & Management

Compiled by	DC
Prepared by	RK
Project Mgr	DC
File No	[illegible]

Figure 5-18

Total SVOC Concentrations

Deep Hydrogeologic Unit

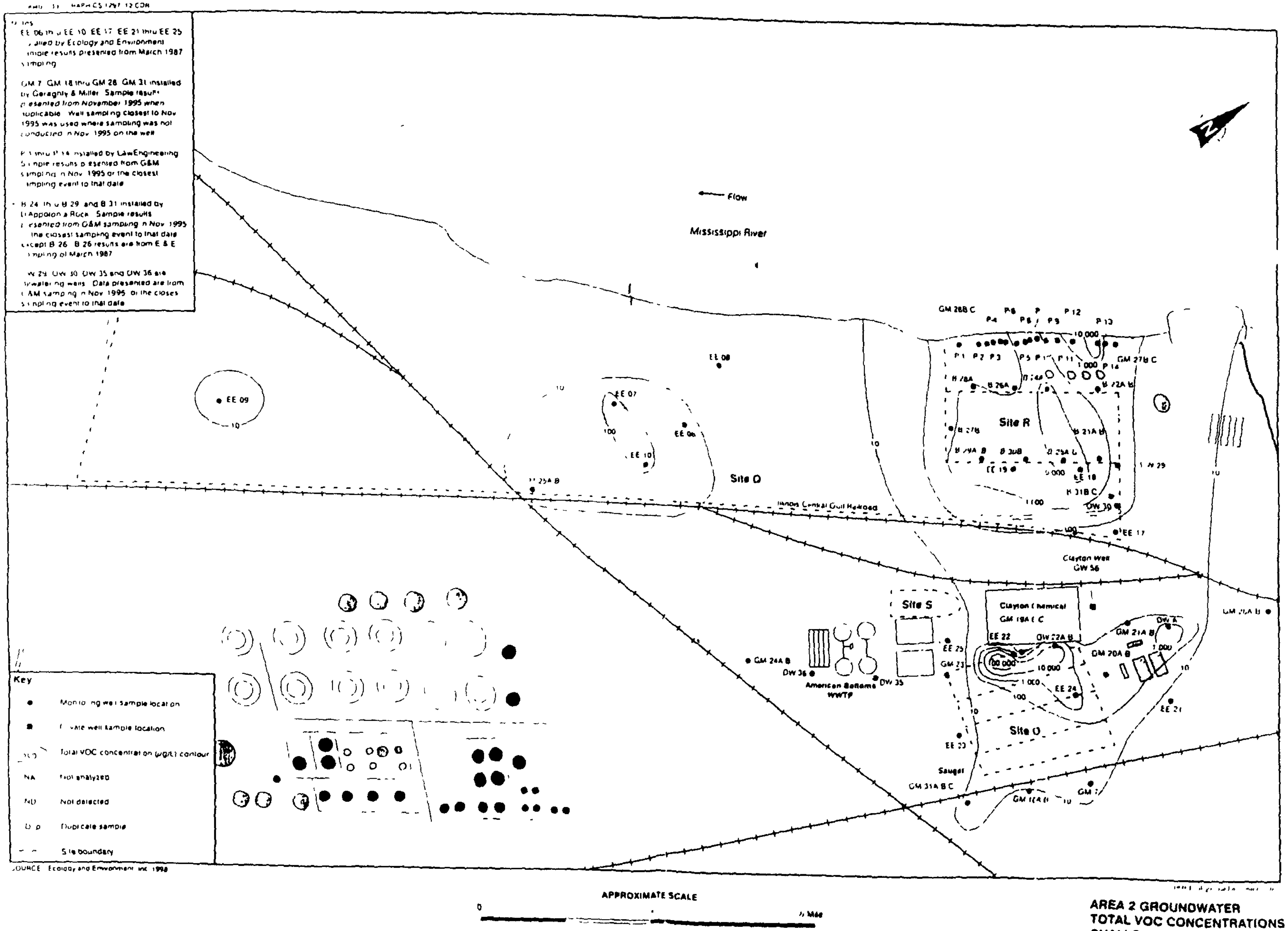


N
10
100
1000
10,000
GM-27C
6920
GM-56C
34,800
GM-60C
1060
MW-3C
238
GM-4C
30
MW-5C
456
GM-62C
(DESTROYED)
GM-19C
316
MW-7C
2800
GM-31C
38
GM-10C
469
GM-12C
32
GM-9C
28
LEGEND
WELL OR WELL
469 CONCENTRATIONS REPORTED
10 — — LINE OF EQUAL CONSTITUENT CONCENTRATION (DASHED WHERE INFERRED)
600'
0
TOTAL SVOC CONCENTRATIONS
DEEP HYDROGEOLOGIC UNIT
W.G. KRUMMRICH PLANT
SAUGET, ILLINOIS
Prepared For
SOLUTIA INC
ROUX
ROUX ASSOCIATES, INC
Environmental Consulting
Compiled by D.C.
Prepared by R.K.
Project Mgr

Figure 5-19

Sauget Area 2

Total VOC Concentrations in Shallow Wells

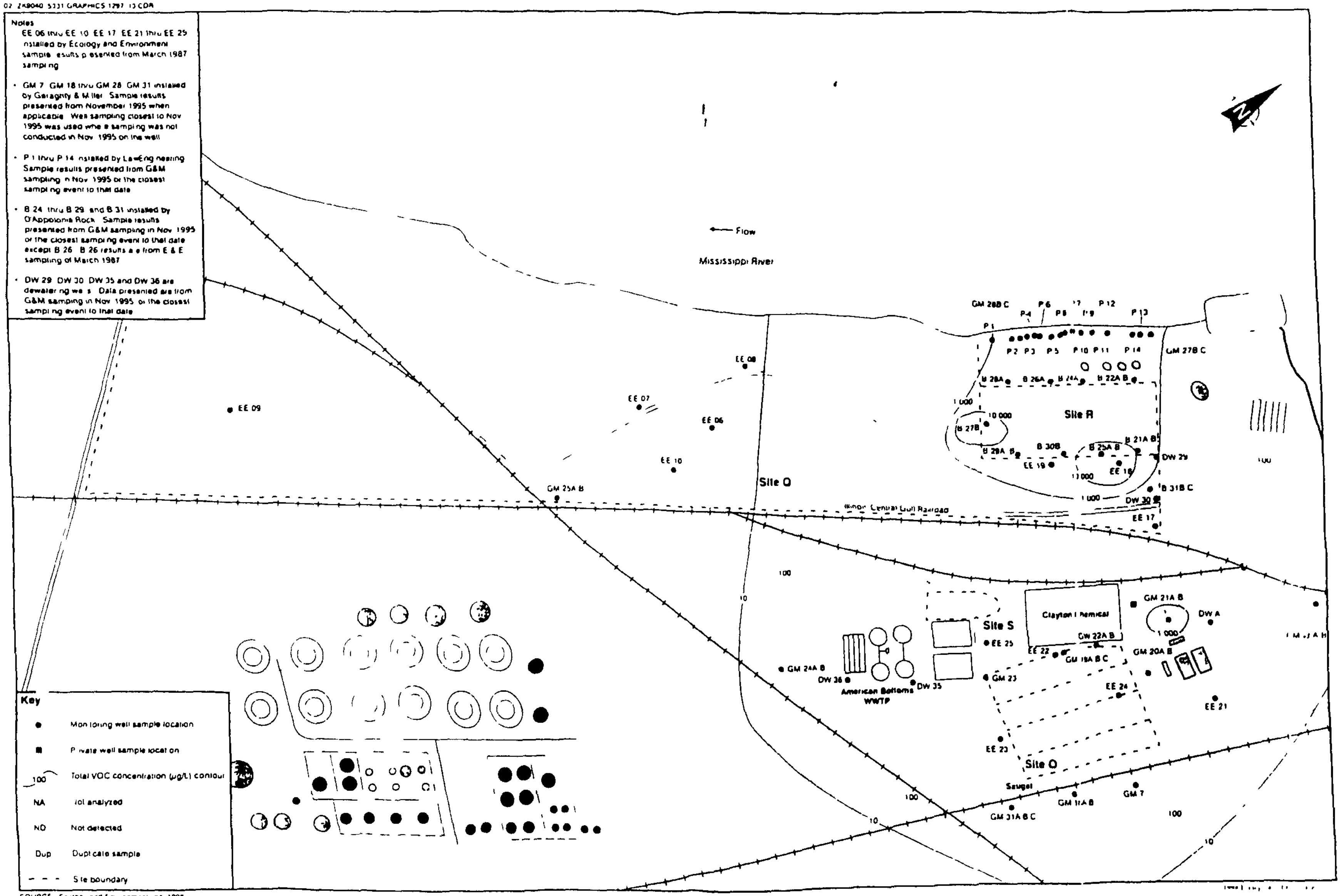


AREA 2 GROUNDWATER
TOTAL VOC CONCENTRATIONS
SHALLOW WELLS

Figure 5-20

Sauget Area 2

Total VOC Concentrations in Intermediate/Deep Wells



SOURCE Ecology and Environment inc 1998

APPROXIMATE SCALE

0 Mile

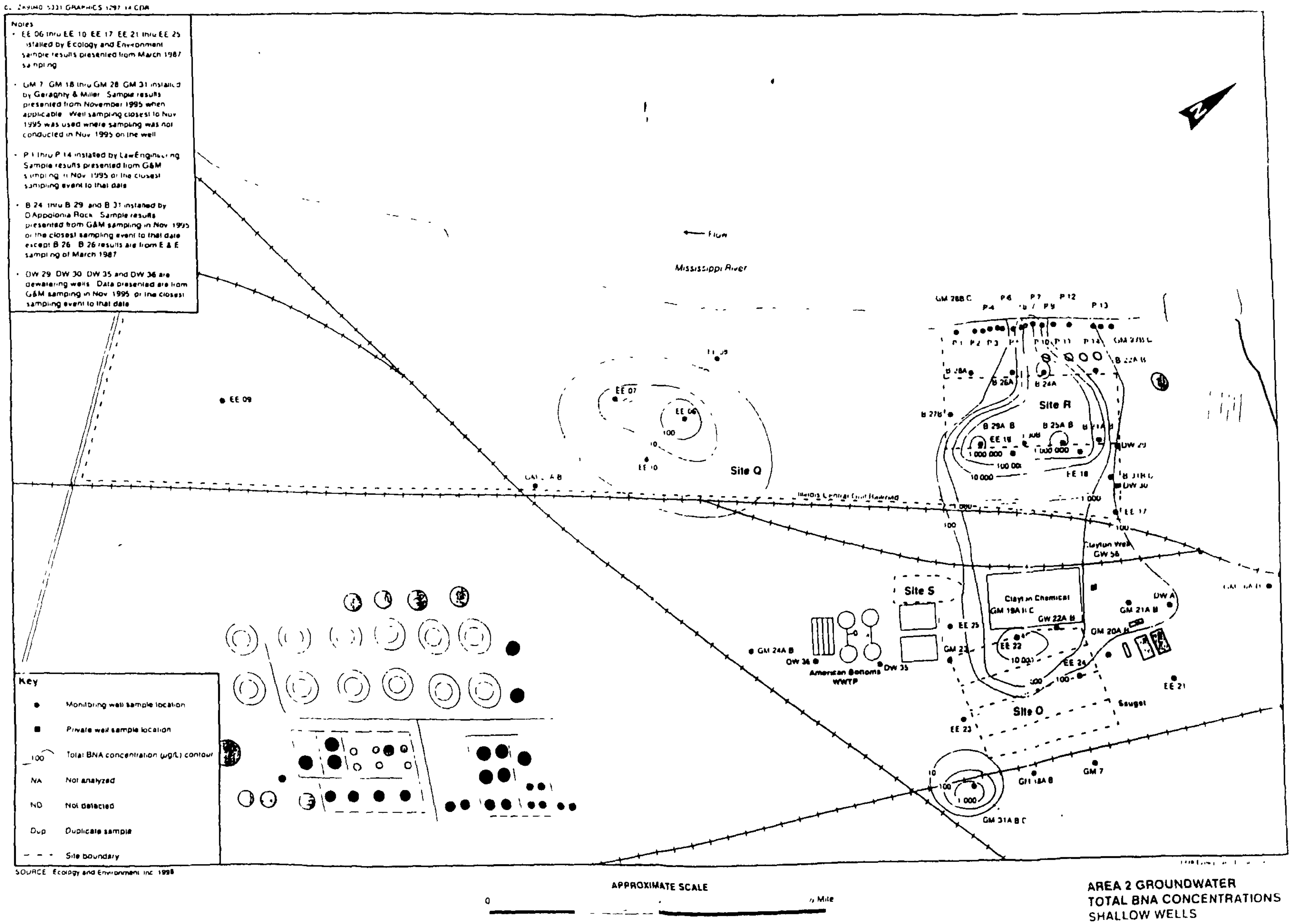
AREA 2 GROUNDWATER
TOTAL VOC CONCENTRATIONS
INTERMEDIATE/DEEP WELLS

Figure 5-21

Sauget Area 2

Total BNA Concentrations

in Shallow Wells



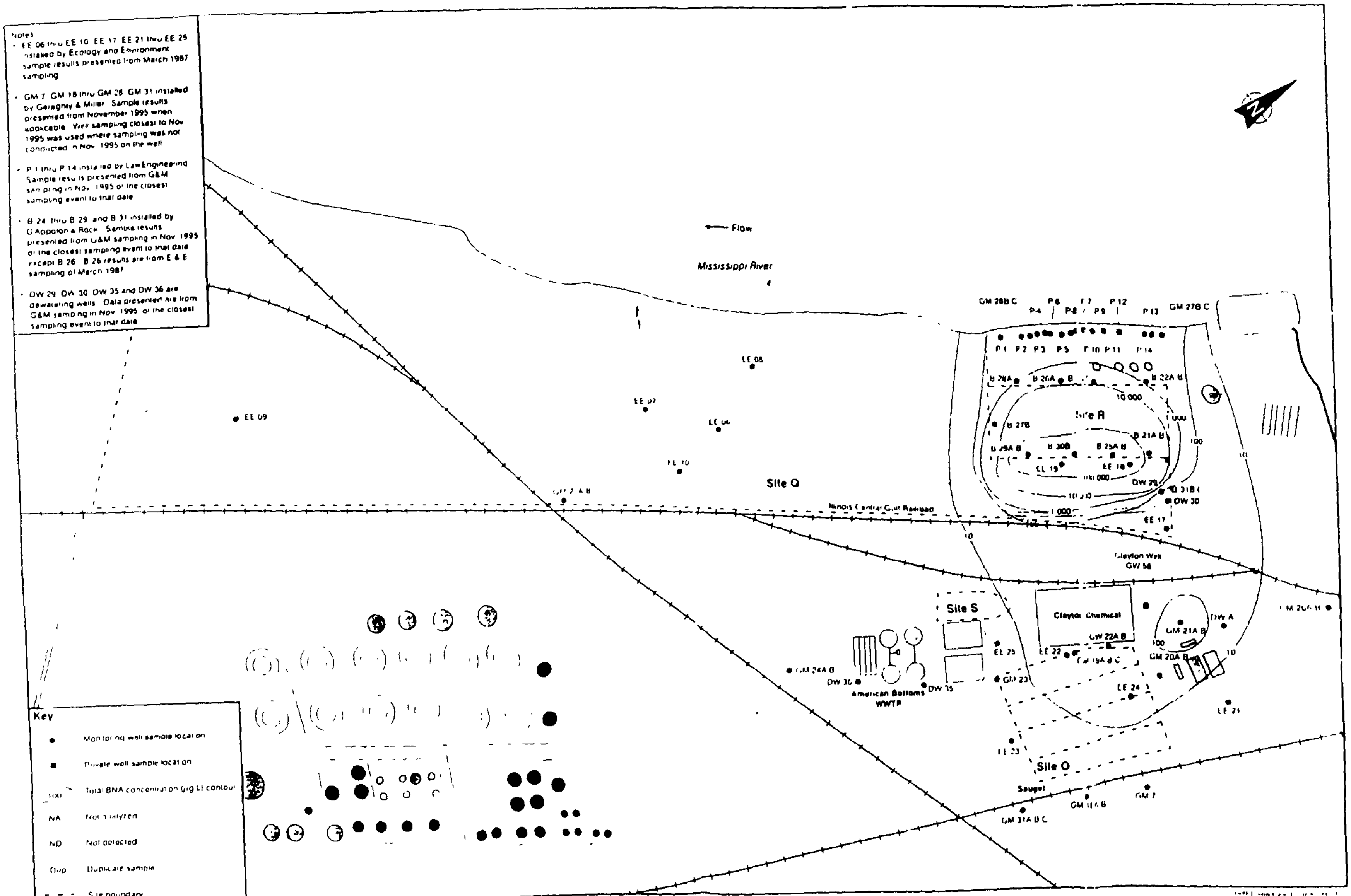
AREA 2 GROUNDWATER
TOTAL BNA CONCENTRATIONS
SHALLOW WELLS

Figure 5-22

Sauget Area 2

Total BNA Concentrations

in Intermediate/Deep Wells

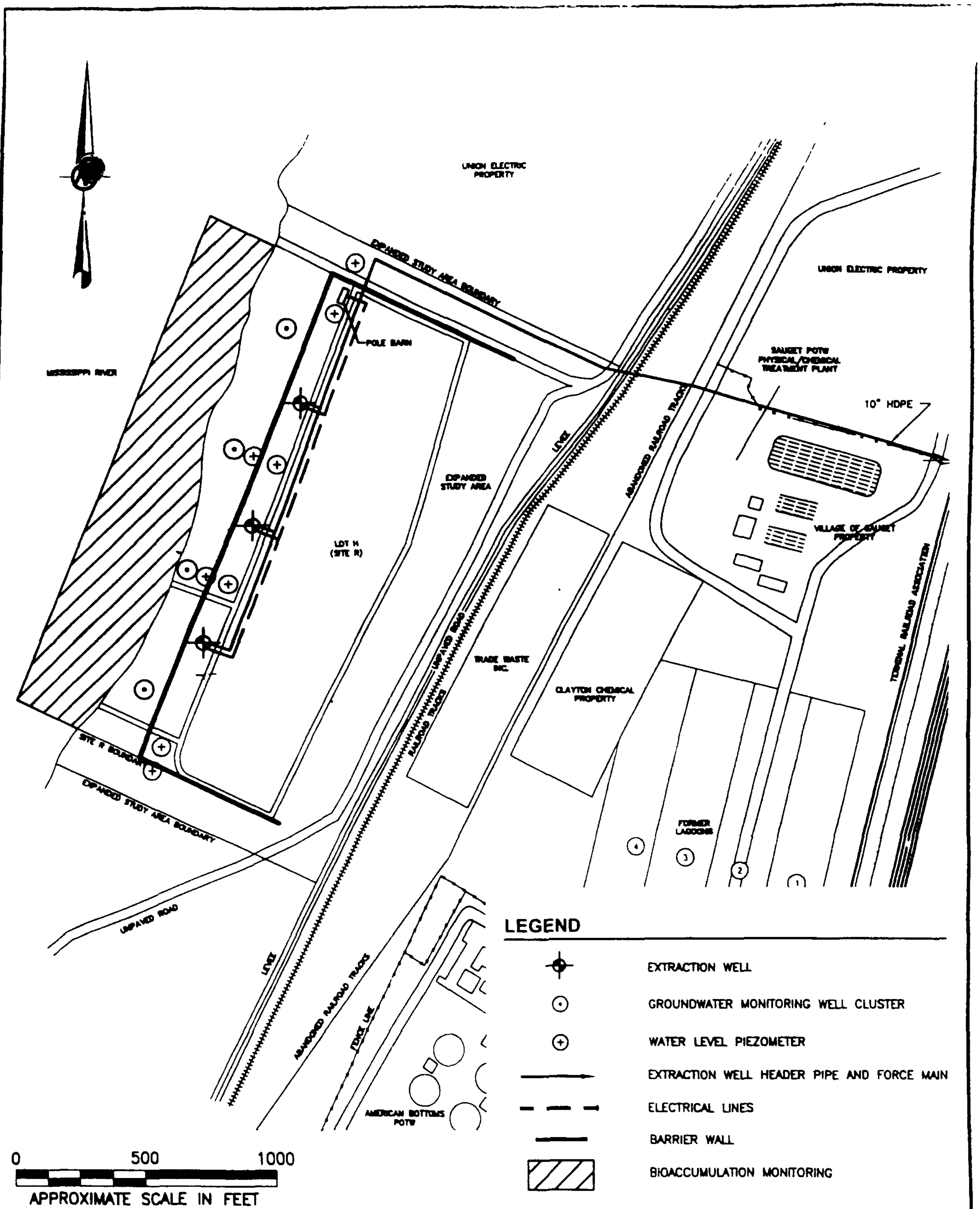


AREA 2 GROUNDWATER
TOTAL BNA CONCENTRATION
INTERMEDIATE/DEEP WELLS

Figure 9-1

Groundwater Alternative 2

Physical Barrier

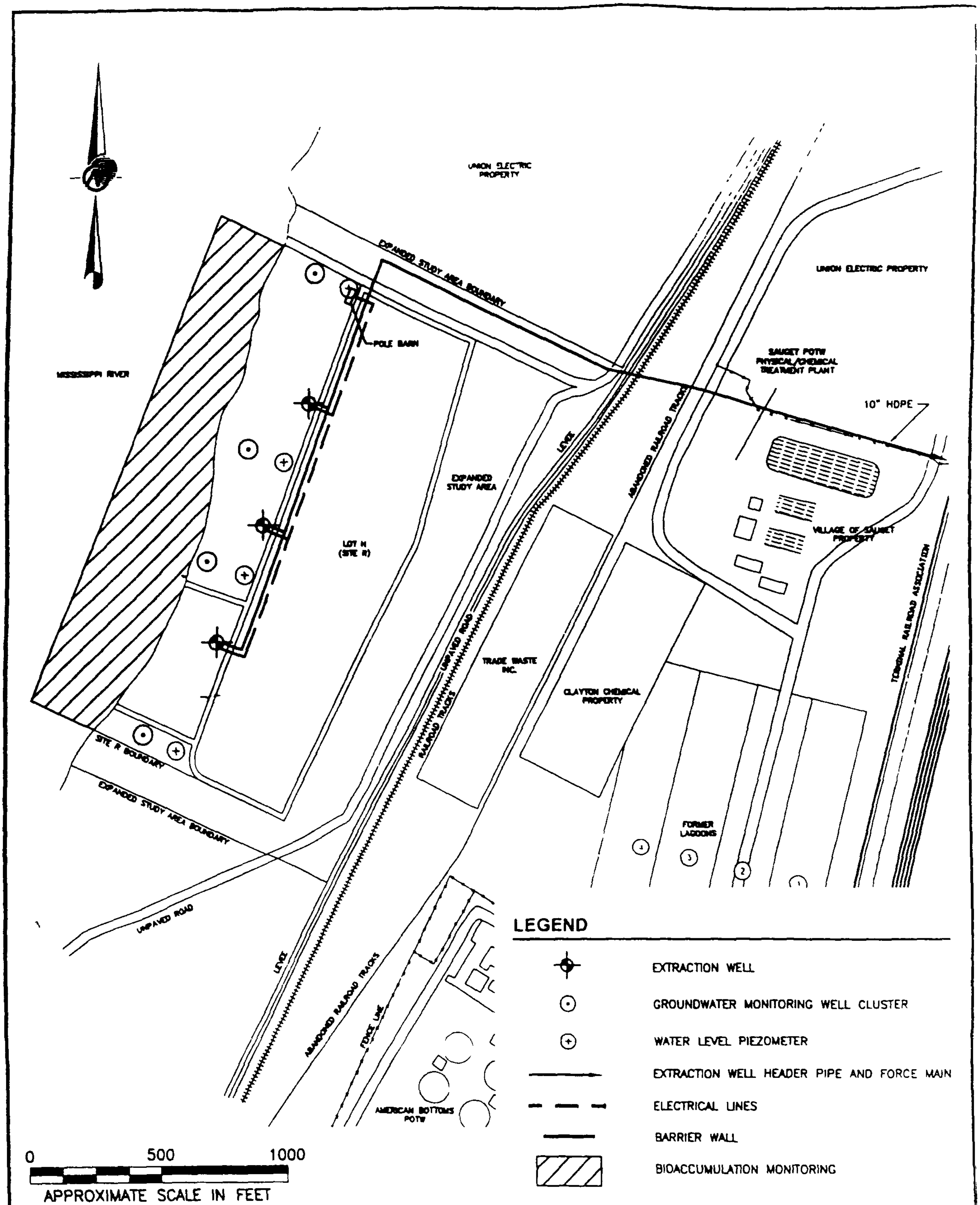


Golder Associates St. Louis, Missouri	SCALE AS SHOWN	TITLE GROUNDWATER ALTERNATIVE B PHYSICAL BARRIER
	DATE 05/20/02	
	DESIGN JRS	
	CADD MSL	INTERIM GROUNDWATER REMEDY FOCUSED FEASIBILITY STUDY
FILE No 9665.5-1	CHECK JRS	FIGURE

Figure 9-2

Groundwater Alternative 3

Hydraulic Barrier



Golder Associates St. Louis, Missouri	SCALE: AS SHOWN	TITLE: GROUNDWATER ALTERNATIVE C HYDRAULIC BARRIER	
	DATE: 03/25/02		
	DESIGN: JRS		
	CADD: MSL	INTERIM GROUNDWATER REMEDY FOCUSED FEASIBILITY STUDY Sauget Area 2 Sauget, Illinois	FIGURE
FILE No. 9665 5-2	CHECK: JRS		
PROJECT No. 013-9665 REV 2	REVIEW		

TABLES

Table 5-1

Surface Water Analytical Data Summary

Table 6-1 Surface Water Screening Table
W G Krummrich Site
Sauget, Illinois

CAS Number	Analysis	Name	Units	Site (PDA) Site Maximum	Site (PDA) Site Average	Site (PDA) Frequency of Detection	Surface Water Quality Criteria SW IL Acute WQ[1]	SW IL Chronic WQ[1]	SW NAWQ CMC[2]	SW NAWQ CCC[2]	SW Tier II Secondary Acute[3]	SW Tier II Secondary Chronic[3]	Oak Ridge Lowest Chronic All Organisms[3]	Downstream (DDA) Reference Downstream Maximum	Downstream Average	2 X Downstream Average	Upstream (UDA) Reference Upstream Maximum	Upstream Average	2 X Upstream Average
3268-87-9	Dioxin	1,2,3,4,6,7,8,9-OCDD	pg/L	189	167.5	100.0%								222	220.6	441	195	182.3	364.6
39001-02-0	Dioxin	1,2,3,4,6,7,8,9-OCDF	pg/L	5.2	4.014	11.1%								ND	ND	ND	ND	ND	ND
35822-46-9	Dioxin	1,2,3,4,6,7,8-HpCDD	pg/L	7	4.603	44.4%								ND	ND	ND	ND	ND	ND
67562-39-4	Dioxin	[redacted]	pg/L	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
55673-89-7	Dioxin	[redacted]	pg/L	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
39227-28-6	Dioxin	[redacted]	pg/L	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
70648-26-9	Dioxin	1,2,3,4,7,8-HxCDF	pg/L	2.2	1.297	11.1%								ND	ND	ND	ND	ND	ND
57653-85-7	Dioxin	[redacted]	pg/L	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
57117-44-9	Dioxin	[redacted]	pg/L	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
19408-74-3	Dioxin	[redacted]	pg/L	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
72918-21-9	Dioxin	[redacted]	pg/L	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
40321-76-4	Dioxin	[redacted]	pg/L	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
57117-41-6	Dioxin	[redacted]	pg/L	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
60851-34-5	Dioxin	[redacted]	pg/L	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
57117-31-4	Dioxin	[redacted]	pg/L	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
1746-01-6	Dioxin	[redacted]	pg/L	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
51207-31-9	Dioxin	[redacted]	pg/L	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
37871-00-4	Dioxin	Total HpCDD	pg/L	12.9	8.387	66.7%								9.4	8.95	17.9	ND	ND	ND
38998-75-3	Dioxin	[redacted]	pg/L	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
34465-46-8	Dioxin	[redacted]	pg/L	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
55684-94-1	Dioxin	Total HxCDF	pg/L	2.2	1.353	11.1%								ND	ND	ND	ND	ND	ND
36088-22-9	Dioxin	[redacted]	pg/L	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
30402-15-4	Dioxin	[redacted]	pg/L	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
41903-57-5	Dioxin	[redacted]	pg/L	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
55722-27-5	Dioxin	[redacted]	pg/L	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
	Dioxin	TEQ Mammal	pg/L	0.307	0.192							3.10E-03[e]		0.0222	0.0221	0.0442	0.0195	0.0182	0.0364
93-76-5	Herbicides	[redacted]	ug/l	ND	ND	0.0%								0.11	0.18	0.36	ND	ND	ND
93-72-1	Herbicides	2,4,5-TP (Silvex)	ug/l	0.14	0.238	11.1%								ND	ND	ND	ND	ND	ND
94-75-7	Herbicides	2,4-D	ug/l	10	3.08	55.6%								0.63	0.48	0.96	ND	ND	ND
94-82-6	Herbicides	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
75-99-0	Herbicides	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
1918-00-9	Herbicides	Dicamba	ug/l	0.11	0.649	11.1%								ND	ND	ND	ND	ND	ND
120-36-5	Herbicides	Dichloroprop	ug/l	1.85	2.69	22.2%								ND	ND	ND	ND	ND	ND
88-85-7	Herbicides	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
94-74-6	Herbicides	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
7085-19-0	Herbicides	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
87-86-5	Herbicides	Pentachlorophenol ([illegible])	ug/l	0.87	0.619	33.3%			19	15				ND	ND	ND	ND	ND	ND
2051-24-3	PCBs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	[illegible]	ND	ND	ND
C-DICHLOROBI	PCBs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	[illegible]	ND	ND	ND
C-HEPTACHLOR	PCBs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	[illegible]	ND	ND	ND
C-HEXACHLORO	PCBs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	[illegible]	ND	ND	ND
C-MONOCHLORO	PCBs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	[illegible]	ND	ND	ND
C-NONACHLORO	PCBs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	[illegible]	ND	ND	ND
C-OCTA-BIPHE	PCBs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	[illegible]	ND	ND	ND
C-PENTBIPHEN	PCBs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	[illegible]	ND	ND	ND
C-TETRACHLOR	PCBs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
C-TOTAL-PCB	PCBs	[redacted]	ug/l	ND	ND	0.0%				0.014[b]		0.14	0.1	ND	ND	ND	ND	ND	ND
C-TRICHLOROB	PCBs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
72-54-8	Pesticides	[redacted]	ug/l	ND	ND	0.0%					0.19[f]	0.011[c]	1.09[f]	ND	ND	ND	ND	ND	ND
72-55-9	Pesticides	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
50-29-3	Pesticides	[redacted]	ug/l	ND	ND	0.0%			1.1	0.001		0.013[d]	0.3[d]	ND	ND	ND	ND	ND	ND
309-00-2	Pesticides	[redacted]	ug/l	ND	ND	0.0%			3.0					ND	ND	ND	ND	ND	ND
319-84-6	Pesticides	[redacted]	ug/l	ND	ND	0.0%					39[d]	2.2[d]	96[e]	ND	ND	ND	ND	ND	ND
5103-71-9	Pesticides	[redacted]	ug/l	ND	ND	0.0%			2.4[f]	0.0043[f]			1.09[f]	ND	ND	ND	ND	ND	ND
319-85-7	Pesticides	[redacted]	ug/l	ND	ND	0.0%					39[d]	2.2[d]	96[f]	ND	ND	ND	ND	ND	ND
319-86-8	Pesticides	[redacted]	ug/l	ND	ND	0.0%					39[d]	2.2[d]	65[e]	ND	ND	ND	ND	ND	ND
60-57-1	Pesticides	[redacted]	ug/l	ND	ND	0.0%			0.24	0.056				ND	ND	ND	ND	ND	ND
959-98-8	Pesticides	[redacted]	ug/l	ND	ND	0.0%			0.22[g]	0.056[g]		0.051		ND	ND	ND	ND	ND	ND
33213-65-9	Pesticides	[redacted]	ug/l	ND	ND	0.0%			0.22[g]	0.056[g]		0.051		ND	ND	ND	ND	ND	ND
1031-07-8	Pesticides	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
72-20-8	Pesticides	[redacted]	ug/l	ND	ND	0.0%			0.086	0.036				ND	ND	ND	ND	ND	ND
7421-93-4	Pesticides	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
53494-70-5	Pesticides	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
58-89-9	Pesticides	[redacted]	ug/l	ND	ND	0.0%			0.95				3.3	ND	ND	ND	ND	ND	ND
5103-74-2	Pesticides	[redacted]	ug/l	ND	ND	0.0%			2.4[f]	0.0043[f]			1.09[f]	ND	ND	ND	ND	ND	ND
76-44-8	Pesticides	[redacted]	ug/l	ND	ND	0.0%			0.52	0.0038	0.125	0.0069	1.26	ND	ND	ND	ND	ND	ND

Table 6-1 Surface Water Screening Table
W.G. Krummrich Site
Sauget, Illinois

				Site (PDA)			Surface Water Quality Criteria							Downstream (DDA) Reference			Upstream (UDA) Reference		
CAS Number	Analysis	Name	Units	Site Maximum	Site Average	Frequency of Detection	SW IL Acute WQ[1]	SW IL Chronic WQ[1]	SW NAWQ CMC[2]	SW NAWQ CCC[2]	SW Tier II Secondary Acute[3]	SW Tier II Secondary Chronic[3]	Oak Ridge Lowest Chronic All Organisms[4]	Downstream Maximum	Downstream Average	2 X Downstream Average	Upstream Maximum	Upstream Average	2 X Upstream Average
1024-57-3	Pesticides	[redacted]	ug/l	ND	ND	0.0%			0.52	0.0038				ND	ND	ND	ND	ND	ND
72-43-5	Pesticides	[redacted]	ug/l	ND	ND	0.0%				0.03		0.019		ND	ND	ND	ND	ND	ND
8001-35-2	Pesticides	[redacted]	ug/l	ND	ND	0.0%			0.73	0.0002				ND	ND	ND	ND	ND	ND
87-61-6	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
120-82-1	SVOCs	1,2,4-Trichlorobenzene	ug/l	1.525	2.25	22.2%					700	110		ND	ND	ND	ND	ND	ND
95-50-1	SVOCs	1,2-Dichlorobenzene	ug/l	13.25	4.82	33.3%					260	14		ND	ND	ND	ND	ND	ND
108-70-3	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
541-73-1	SVOCs	[redacted]	ug/l	ND	ND	0.0%					630	71		ND	ND	ND	ND	ND	ND
106-46-7	SVOCs	[redacted]	ug/l	ND	ND	0.0%					160	15		ND	ND	ND	ND	ND	ND
108-60-1	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
15950-66-0	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
933-78-8	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
933-7-5	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
95-95-4	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
88-06-2	SVOCs	2,4,6-Trichlorophenol	ug/l	8	3.62	44.4%								ND	ND	ND	ND	ND	ND
120-83-2	SVOCs	2,4-Dichlorophenol	ug/l	31	9.84	44.4%								1	1.76	3.5	ND	ND	ND
105-67-9	SVOCs	2,4-Dimethylphenol	ug/l	3.7	2.62	33.3%								ND	ND	ND	ND	ND	ND
51-28-5	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
121-14-2	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
606-20-2	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
91-58-7	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
95-57-8	SVOCs	2-Chlorophenol	ug/l	20	6.9	44.4%								0.36	1.43	2.86	ND	ND	ND
91-57-6	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
95-48-7	SVOCs	[redacted]	ug/l	ND	ND	0.0%					230	13	409	ND	ND	ND	ND	ND	ND
88-74-4	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
88-75-5	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
91-94-1	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
609-19-8	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
106-44-5	SVOCs	3-Methylphenol/4-Methylphenol (m&p-Cresol)	ug/l	11	3.93	33.3%								ND	ND	ND	ND	ND	ND
99-09-2	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
534-52-1	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
101-55-3	SVOCs	[redacted]	ug/l	ND	ND	0.0%						1.6		ND	ND	ND	ND	ND	ND
59-50-7	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
106-47-8	SVOCs	4-Chloroaniline	ug/l	46	14.1	44.4%								1.6	3.3	6.6	ND	ND	ND
7005-72-3	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
100-01-6	SVOCs	[redacted]	ug/l	ND	ND	0%								ND	ND	ND	ND	ND	ND
100-02-7	SVOCs	[redacted]	ug/l	ND	ND	0.0%					1200	300	481	ND	ND	ND	ND	ND	ND
83-32-9	SVOCs	[redacted]	ug/l	ND	ND	0.0%							74	ND	ND	ND	ND	ND	ND
208-96-8	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
120-12-7	SVOCs	[redacted]	ug/l	ND	ND	0.0%					13	0.73	0.09	ND	ND	ND	ND	ND	ND
56-55-3	SVOCs	[redacted]	ug/l	ND	ND	0.0%					0.49	0.027	0.66	ND	ND	ND	ND	ND	ND
50-32-8	SVOCs	[redacted]	ug/l	ND	ND	0.0%					0.24	0.014	0.30	ND	ND	ND	ND	ND	ND
205-99-2	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
191-24-2	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
207-08-9	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
111-91-1	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
111-44-4	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
117-81-7	SVOCs	bis(2-Ethylhexyl)phthalate	ug/l	2.2	2.56	11.1%					27	3.0	912	ND	ND	ND	ND	ND	ND
85-68-7	SVOCs	[redacted]	ug/l	ND	ND	0.0%						19		ND	ND	ND	ND	ND	ND
86-74-8	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
218-01-9	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
84-74-2	SVOCs	Di-n-butylphthalate	ug/l	0.34	2.11	22.2%					190	35	697	ND	ND	ND	ND	ND	ND
117-84-0	SVOCs	[redacted]	ug/l	ND	ND	0.0%							708	ND	ND	ND	ND	ND	ND
53-70-3	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
132-64-9	SVOCs	[redacted]	ug/l	ND	ND	0.0%					66	3.7	1000	ND	ND	ND	ND	ND	ND
84-66-2	SVOCs	[redacted]	ug/l	ND	ND	0.0%					1800	210	85600	ND	ND	ND	ND	ND	ND
131-11-3	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
206-44-0	SVOCs	[redacted]	ug/l	ND	ND	0.0%							16	ND	ND	ND	ND	ND	ND
86-73-7	SVOCs	[redacted]	ug/l	ND	ND	0.0%					70	3.9		ND	ND	ND	ND	ND	ND
118-74-1	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
87-68-3	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
77-47-4	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
67-72-1	SVOCs	[redacted]	ug/l	ND	ND	0.0%					210	12		ND	ND	ND	ND	ND	ND
193-39-5	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
78-59-1	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
621-64-7	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
86-30-6	SVOCs	[redacted]	ug/l	ND	ND	0.0%					3600	210	332	ND	ND	ND	ND	ND	ND

CAS Number	Analysis	Name	Units	Site (PDA) Site Maximum	Site Average	Frequency of Detection	Surface Water Quality Criteria SW IL Acute WQ[1]	SW IL Chronic WQ[1]	SW NAWQ CMC[2]	SW NAWQ CCC[2]	SW Tier II Secondary Acute[3]	SW Tier II Secondary Chronic[3]	Oak Ridge Lowest Chronic All Organisms[3]	Downstream (DDA) Reference Downstream Maximum	Downstream Average	2 X Downstream Average	Upstream (UDA) Reference Upstream Maximum	Upstream Average	2 X Upstream Average
91-20-3	SVOCs	[redacted]	ug/l	ND	ND	0.0%					190	12	620	ND	ND	ND	ND	ND	ND
98-95-3	SVOCs	Nitrobenzene	ug/l	0.93	2.2	22.2%								ND	ND	ND	ND	ND	ND
95-01-8	SVOCs	[redacted]	ug/l	ND	ND	0.0%							200	ND	ND	ND	ND	ND	ND
108-95-2	SVOCs	Phenol	ug/l	15	3.89	11.1%								ND	ND	ND	ND	ND	ND
129-00-0	SVOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
71-55-6	VOCs		ug/l	ND	ND	0.0%					200	11	3400	ND	ND	ND	ND	ND	ND
79-34-5	VOCs		ug/l	ND	ND	0.0%					2100	610	2400	ND	ND	ND	ND	ND	ND
79-00-5	VOCs		ug/l	ND	ND	0.0%					6200	4200	9400	ND	ND	ND	ND	ND	ND
75-34-3	VOCs		ug/l	ND	ND	0.0%					830	47	14660	ND	ND	ND	ND	ND	ND
75-35-4	VOCs		ug/l	ND	ND	0.0%					450	25		ND	ND	ND	ND	ND	ND
107-06-2	VOCs	1,2-Dichloroethane	ug/l	0.776	0.872	33.3%					8800	910	18200	ND	ND	ND	ND	ND	ND
78-87-5	VOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
78-93-3	VOCs		ug/l	ND	ND	0.0%					240000	14000	282170	ND	ND	ND	9	7	14
591-78-6	VOCs		ug/l	ND	ND	0.0%					1800	99	32783	ND	ND	ND	ND	ND	ND
108-10-1	VOCs	4-Methyl-2-pentanone (MIBK)	ug/l	2.2	2.01	33.3%					2200	170	77400	ND	ND	ND	ND	ND	ND
67-64-1	VOCs	[redacted]	ug/l	ND	ND	0.0%					28000	1500	507640	ND	ND	ND	ND	ND	ND
71-43-2	VOCs	Benzene	ug/l	1.8	1.17	22.2%					2300	130	526000	0.24	0.196	0.39	0.785	0.8925	1.785
75-27-4	VOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
75-25-2	VOCs		ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
74-83-9	VOCs		ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
75-15-0	VOCs		ug/l	ND	ND	0.0%					17	0.92	244	ND	ND	ND	ND	ND	ND
56-23-5	VOCs		ug/l	ND	ND	0.0%					180	9.8	1970	ND	ND	ND	0.73	0.885	1.73
108-90-7	VOCs	Chlorobenzene	ug/l	24	7.69	66.7%					1100	64	1203	2.3	1.75	3.5	0.776	0.8875	1.775
75-00-3	VOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
67-66-3	VOCs		ug/l	ND	ND	0.0%					480	28	1240	ND	ND	ND	ND	ND	ND
74-87-3	VOCs		ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
156-59-2	VOCs		ug/l	ND	ND	0.0%					1100^{h}	590^{h}	9636^{h}	ND	ND	ND	ND	ND	ND
10061-01-5	VOCs		ug/l	ND	ND	0.0%					0.06^{i}	0.066^{i}	244^{i}	ND	ND	ND	ND	ND	ND
124-48-1	VOCs		ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
100-41-4	VOCs	Ethylbenzene	ug/l	0.38	0.668	44.4%					130	7.3		ND	ND	ND	ND	ND	ND
108-38-3	VOCs	m&p-Xylene	ug/l	2.4	1.09	44.4%					32	1.8		ND	ND	ND	ND	ND	ND
75-09-2	VOCs	[redacted]	ug/l	ND	ND	0.0%					26000	2200	42067	ND	ND	ND	ND	ND	ND
100-42-5	VOCs		ug/l	ND	ND	0.0%								ND	ND	ND	ND	ND	ND
127-18-4	VOCs		ug/l	ND	ND	0.0%					830	98	790	ND	ND	ND	ND	ND	ND
108-88-3	VOCs	Toluene	ug/l	1.7	1.19	33.3%					120	9.8	1269	0.4	0.7	1.4	ND	ND	ND
156-60-5	VOCs	[redacted]	ug/l	ND	ND	0.0%					1100^{h}	590^{h}	9636^{h}	ND	ND	ND	ND	ND	ND
10061-02-6	VOCs		ug/l	ND	ND	0.0%					0.06^{i}	0.066^{i}	244^{i}	ND	ND	ND	ND	ND	ND
79-01-6	VOCs	Trichloroethene	ug/l	0.3	0.822	11.1%					440	47	7267	ND	ND	ND	ND	ND	ND
75-01-4	VOCs	[redacted]	ug/l	ND	ND	0.0%								ND	ND	ND	0.876	0.8375	1.675
1330-20-7	VOCs	Xylenes, Total	ug/l	2.7	1.16	44.4%					230	13	82500	ND	ND	ND	ND	ND	ND

Notes

[1] Illinois 1999 Title 35 of the Illinois Administrative Code, Subtitle C, Chapter 1, Part 302 Water Quality Standards, Subpart B

[2] USEPA, 1999 National Recommended Water Quality Criteria - Correction. Office of Water, EPA 82-2-Z-99-001 (April 1999)

[3] Suter G W II and C L Tsao 1996 Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota 1996 Revision. Risk Assessment, Health Sciences Research Division Oak Ridge Tennessee ES/ER/TM

[4] USEPA, 1995 Great Lakes Water Quality Initiative Criteria Documents for the Protection of Wildlife DDT Mercury, 2,3,7,8-TCDD PCBs Office of Water, EPA 820-B-95-008

[b] Value for PCBs

[c] Value for DDD p p

[d] Value for DDT

[e] Value for BHC (other)

[f] Value for Chlordane

[g] Value for alpha- and beta-Endosulfan

[h] Value for 1,2-Dichloroethene

[i] Value for 1 3-Dichloropropene

Not detected [illegible]

Site maximum concentration is less than the UDA and DDA maximum concentrations

Site maximum concentration is less than the screening criteria

Table 5-2

Sediment Analytical Data Summary

Table 6-2 Sediment Screening Table
W G Krummrich Site
Sauget, Illinois

				Site (PDA)			Sediment Quality Criteria			Downstream (DDA) Reference			Upstream (UDA) Reference		
CAS Number	Analysis	Name	Units	Site Maximum	Site Average	Frequency of Detection	Sed Qual Guide[1] (TEC)	Sed FL SQAG[2] (TEL)	Sed Ontario[3] (LEL)	Downstream Maximum	Downstream Average	2 X Downstream Average	Upstream Maximum	Upstream Average	2 X Upstream Average
3268-87-9	Dioxin	1,2,3,4,6,7,8,9-OCDD	pg/g	911	166 6	100%				1180	596.2	1192.4	287	149 4	298 8
39001-02-0	Dioxin	1,2,3,4,6,7,8,9-OCDF	pg/g	74,9	10 76	56%				14,3	7 44	14 88	6 2	3 288	6 576
35822-46-9	Dioxin	1,2,3,4,6,7,8-HpCDD	pg/g	70 8	10,84	100%				31 3	15 75	31 5	11 1	5 7	11 4
67562-39-4	Dioxin	1,2,3,4,6,7,8-HpCDF	pg/g	10 4	1 616	11%				3	1 65	3 1	ND	ND	ND
55673-89-7	Dioxin	1,2,3,4,7,8,9-HpCDF	pg/g	0 79	0 3511	33%				ND	ND	ND	ND	ND	ND
39227-28-6	Dioxin	[redacted]	pg/g	ND	ND	ND				ND	ND	ND	ND	ND	ND
70648-26-9	Dioxin	1,2,3,4,7,8-HxCDF	pg/g	0 62	0 4178	78%				ND	ND	ND	0 27	0 1975	0 395
57653-85-7	Dioxin	1,2,3,6,7,8-HxCDD	pg/g	1,2	0 3183	22%				ND	ND	ND	0 37	0 2725	0 545
57117-44-9	Dioxin	1,2,3,6,7,8-HxCDF	pg/g	0 38	0 1944	22%				ND	ND	ND	ND	ND	ND
19408-74-3	Dioxin	[redacted]	pg/g	ND	ND	ND				ND	ND	ND	0 35	0 2625	[illegible]
72918-21-9	Dioxin		pg/g	ND	ND	ND				ND	ND	ND	ND	ND	ND
40321-76-4	Dioxin		pg/g	ND	ND	ND				ND	ND	ND	ND	ND	ND
57117-41-6	Dioxin	1,2,3,7,8-PeCDF	pg/g	0 48	0 2033	11%				ND	ND	ND	ND	ND	ND
60851-34-5	Dioxin	2,3,4,6,7,8-HxCDF	pg/g	0 195	0 1606	11%				ND	ND	ND	ND	ND	ND
57117-31-4	Dioxin	2 3,4,7,8-PeCDF	pg/g	0 18	0,17	11%				ND	ND	ND	ND	ND	ND
1746-01-6	Dioxin	[redacted]	pg/g	ND	ND	ND				ND	ND	ND	ND	ND	ND
51207-31-9	Dioxin	2,3,7,8-TCDF	pg/g	0 8	0 3006	33%				ND	ND	ND	ND	ND	ND
37871-00-4	Dioxin	Total HpCDD	pg/g	146	22 53	100%				75 3	37 94	75 88	23	11 82	23 64
38998-75-3	Dioxin	Total HpCDF	pg/g	64,2	7 414	56%				12 9	6 5	13	5 3	2 713	5 4.6
34465-46-8	Dioxin	Total HxCDD	pg/g	11 7	2 058	44%				7 3	3 7	7 4	3 3	1 738	3 476
55684-94-1	Dioxin	Total HxCDF	pg/g	10 1	2 031	78%				2 3	1 2	2 4	2 4	1 263	2 526
36088-22 9	Dioxin	Total PeCDD	pg/g	0 25	0 2194	11%				ND	ND	ND	0 51	0 355	0 71
30402-15-4	Dioxin	Total PeCDF	pg/g	2 7	0 6669	33%				ND	ND	ND	0 66	0 3925	0 785
41903-57-5	Dioxin	Total TCDD	pg/g	42.8	6 796	44%				3 1	1 625	3 25	0 25	0 225	0 45
55722-27-5	Dioxin	Total TCDF	pg/g	1 4	0 4883	33%				ND	ND	ND	ND	ND	ND
	Dioxin	TEQ Mammal	pg/g	1 36	0 379					0 462	0 233	0 466	0 239	0 145	0 292
93-76-5	Herbicides	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
93-72-1	Herbicides		ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
94-75-7	Herbicides	2,4-D	ug/kg dw	2300	277	22%				ND	ND	ND	ND	ND	ND
94-82-6	Herbicides	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
75-99-0	Herbicides		ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
1918-00-9	Herbicides		ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
120-36-5	Herbicides	Dichloroprop	ug/kg dw	1100	165	44%				ND	ND	ND	ND	ND	ND
88-85-7	Herbicides	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
94-74-6	Herbicides		ug/kg dw	NC	ND	ND				ND	ND	ND	ND	ND	ND ND
7085-19-0	Herbicides	MCPP[2-(4-chloro-2-methylphenoxy)-propanoic acid]	ug/kg dw	160000	19600	56%				ND	ND	ND	ND	ND	ND
87-86-5	Herbicides	Pentachlorophenol	ug/kg dw	45	13 7	11%				1 6	7 8	15 6	1 65	8 03	16 06
2051-24-3	PCBs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
C-DICHLOROBI	PCBs		ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
C-HEPTACHLOR	PCBs		ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
C-HEXACHLORO	PCBs		ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
C-MONOCHLORO	PCBs		ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
C-NONACHLORO	PCBs		ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
C-OCTA-BIPHE	PCBs		ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
C-PENTBIPHEN	PCBs		ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
C-TETRACHLOR	PCBs		ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
C-TOTAL-PCB	PCBs		ug/kg dw	ND	ND	ND	59 8	21 6	70	ND	ND	ND	ND	ND	ND
C-TRICHLOROB	PCBs		ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
72-54-8	Pesticides	4,4'-DDD	ug/kg dw	1,8	2,04	11%	4 82	1.22	8	ND	ND	ND	ND	ND	ND
72-55-9	Pesticides	[redacted]	ug/kg dw	ND	ND	ND	3 16	2.07	5	ND	ND	ND	ND	ND	ND
50-29-3	Pesticides		ug/kg dw	ND	ND	ND	4 16	1 19	8	ND	ND	ND	ND	ND	ND
309-00-2	Pesticides		ug/kg dw	ND	ND	ND			2	ND	ND	ND	ND	ND	ND
319-84-6	Pesticides		ug/kg dw	ND	ND	ND			6	ND	ND	ND	ND	ND	ND
5103-71-9	Pesticides		ug/kg dw	ND	ND	ND	3.24	2.26	7	ND	ND	ND	ND	ND	ND
319-85-7	Pesticides		ug/kg dw	ND	ND	ND			5	ND	ND	ND	ND	ND	ND
319-86-8	Pesticides		ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
60-57-1	Pesticides		ug/kg dw	ND	ND	ND	1.9	0 715	2	ND	ND	ND	ND	ND	ND
959-98-8	Pesticides		ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
33213-65-9	Pesticides		ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
1031-07-8	Pesticides		ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
72-20-8	Pesticides		ug/kg dw	ND	ND	ND	2 22		3	ND	ND	ND	ND	ND	ND

Table 6-2. Sediment Screening Table
W G. Krummrich Site
Sauget, Illinois

CAS Number	Analysis	Name	Units	Site (PDA) Site Maximum	Site (PDA) Site Average	Site (PDA) Frequency of Detection	Sediment Quality Criteria Sed Qual Guide[1] (TEC)	Sediment Quality Criteria Sed FL SQAG[2] (TEL)	Sediment Quality Criteria Sed Ontario[3] (LEL)	Downstream (DDA) Reference Downstream Maximum	Downstream (DDA) Reference Downstream Average	Downstream (DDA) Reference 2 X Downstream Average	Upstream (UDA) Reference Upstream Maximum	Upstream (UDA) Reference Upstream Average	Upstream (UDA) Reference 2 X Upstream Average
7421-93-4	Pesticides	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
53494-70-5	Pesticides	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
58-89-9	Pesticides	[redacted]	ug/kg dw	ND	ND	ND	2.37	0.32	3	ND	ND	ND	ND	ND	ND
5103-74-2	Pesticides	[redacted]	ug/kg dw	ND	ND	ND	3.24	2.28	7	ND	ND	ND	ND	ND	ND
76-44-8	Pesticides	[redacted]	ug/kg dw	ND	ND	ND			0.3***	ND	ND	ND	ND	ND	ND
1024-57-3	Pesticides	[redacted]	ug/kg dw	ND	ND	ND	2.47		5	ND	ND	ND	ND	ND	ND
72-43-5	Pesticides	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
8001-35-2	Pesticides	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
87-61-6	SVOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
120-82-1	SVOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
95-50-1	SVOCs	1,2-Dichlorobenzene	ug/kg dw	110	100	22%				ND	ND	ND	ND	ND	ND
106-70-3	SVOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
541-73-1	SVOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
106-46-7	SVOCs	1,4-Dichlorobenzene	ug/kg dw	81.5	106	11%				ND	ND	ND	ND	ND	ND
108-60-1	SVOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
15950-66-0	SVOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
933-78-8	SVOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
933-7-5	SVOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
95-95-4	SVOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
88-06-2	SVOCs	2,4,6-Trichlorophenol	ug/kg dw	470	144	22%				ND	ND	ND	ND	ND	ND
120-83-2	SVOCs	2,4-Dichlorophenol	ug/kg dw	1000	208	22%				ND	ND	ND	ND	ND	ND
105-67-9	SVOCs	2,4-Dimethylphenol	ug/kg dw	80	98.1	22%				ND	ND	ND	ND	ND	ND
51-28-5	SVOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
121-14-2	SVOCs	2,4-Dinitrotoluene	ug/kg dw	750	196	22%				ND	ND	ND	ND	ND	ND
606-20-2	SVOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
91-58-7	SVOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
95-57-8	SVOCs	2-Chlorophenol	ug/kg dw	360	137	11%				ND	ND	ND	ND	ND	ND
91-57-6	SVOCs	[redacted]	ug/kg dw	ND	ND	ND		20.2		ND	ND	ND	ND	ND	ND
95-48-7	SVOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
88-74-4	SVOCs	2-Nitroaniline	ug/kg dw	76	471	11%				ND	ND	ND	ND	ND	ND
88-75-5	SVOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
91-94-1	SVOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
609-19-8	SVOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
106-44-5	SVOCs	3-Methylphenol/4-Methylphenol (m&p-Cresol)	ug/kg dw	ou0	192	22%				ND	ND	ND	ND	ND	ND
99-09-2	SVOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
534-52-1	SVOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
101-55-3	SVOCs	4-Bromophenylphenyl ether	ug/kg dw	98.6	108	11%				ND	ND	ND	ND	ND	ND
59-50-7	SVOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
106-47-8	SVOCs	4-Chloroaniline	ug/kg dw	4800	1080	67%				ND	ND	ND	ND	ND	ND
7005-72-3	SVOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
100-01-6	SVOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
100-02-7	SVOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
83-32-9	SVOCs	[redacted]	ug/kg dw	ND	ND	ND		6.71		ND	ND	ND	ND	ND	ND
208-96-8	SVOCs	[redacted]	ug/kg dw	ND	ND	ND		5.87		ND	ND	ND	ND	ND	ND
120-12-7	SVOCs	[redacted]	ug/kg dw	ND	ND	ND	57.2	46.9	220	ND	ND	ND	ND	ND	ND
56-55-3	SVOCs	[redacted]	ug/kg dw	ND	ND	ND	108	74.8	320	48	75.5	151	ND	ND	ND
50-32-8	SVOCs	[redacted]	ug/kg dw	ND	ND	ND	150	88.8	370	ND	ND	ND	ND	ND	ND
205-99-2	SVOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
191-24-2	SVOCs	[redacted]	ug/kg dw	ND	ND	ND			170	ND	ND	ND	ND	ND	ND
207-08-9	SVOCs	[redacted]	ug/kg dw	ND	ND	ND			240	ND	ND	ND	ND	ND	ND
111-91-1	SVOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
111-44-4	SVOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
117-81-7	SVOCs	[redacted]	ug/kg dw	ND	ND	ND		182		ND	ND	ND	ND	ND	ND
85-68-7	SVOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	110	109	218
86-74-8	SVOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
218-01-9	SVOCs	[redacted]	ug/kg dw	ND	ND	ND	166	108	340	49	77	154	ND	ND	ND
84-74-2	SVOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
117-84-0	SVOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
53-70-3	SVOCs	[redacted]	ug/kg dw	ND	ND	ND	33	6.22	60	ND	ND	ND	ND	ND	ND
132-64-9	SVOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
84-66-2	SVOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
131-11-3	SVOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND

Table 6-2 Sediment screening Table
W G Krummrich Site
Sauget, Illinois

CAS Number	Analysis	Name	Units	Site (PDA) Site Maximum	Site Average	Frequency of Detection	Sediment Quality Criteria Sed Qual Guide[1] (TEC)	Sed FL SQAG[2] (TEL)	Sed Ontario[3] (LEL)	Downstream (DDA) Reference Downstream Maximum	Downstream Average	2 X Downstream Average	Upstream (UDA) Reference Upstream Maximum	Upstream Average	2 X Upstream Average
208-44-0	SVOCs	[redacted]	ug/kg dw	ND	ND	ND	423	113	760	ND	ND	ND	ND	ND	ND
86-73-7	SVOCs		ug/kg dw	ND	ND	ND	77.4	21.2	190	ND	ND	ND	ND	ND	ND
118-74-1	SVOCs		ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
87-68-3	SVOCs		ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
77-47-4	SVOCs		ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
67-72-1	SVOCs		ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
193-39-5	SVOCs		ug/kg dw	ND	ND	ND			200	ND	ND	ND	ND	ND	ND
78-59-1	SVOCs		ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
621-64-7	SVOCs		ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
86-30-6	SVOCs		ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
91-20-3	SVOCs	Naphthalene	ug/kg dw	190	118	11%	176	34.6	·	ND	ND	ND	ND	ND	ND
98-95-3	SVOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
85-01-8	SVOCs		ug/kg dw	ND	ND	ND	204	86.7	560	ND	ND	ND	ND	ND	ND
108-95-2	SVOCs	Phenol	ug/kg dw	5600	719	11%				ND	ND	ND	ND	ND	ND
129-00-0	SVOCs	[redacted]	ug/kg dw	ND	ND	ND	195	153	490	ND	ND	ND	ND	ND	ND
71-55-6	VOCs		ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
79-34-5	VOCs		ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
79-00-5	VOCs		ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
75-34-3	VOCs		ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
75-35-4	VOCs		ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
107-06-2	VOCs	1,2-Dichloroethane	ug/kg dw	280	51.1	33%				ND	ND	ND	ND	ND	ND
78-87-5	VOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
78-93-3	VOCs	2-Butanone (MEK)	ug/kg dw	91	18.6	33%				ND	ND	ND	23	12.9	25.8
591-78-6	VOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
108-10-1	VOCs	4-Methyl-2-pentanone (MIBK)	ug/kg dw	160	35.2	56%				ND	ND	ND	ND	ND	ND
67-64-1	VOCs	Acetone	ug/kg dw	3000	418	67%				41	22.9	45.8	130	68.5	137
71-43-2	VOCs	Benzene	ug/kg dw	460	98.3	89%				ND	ND	ND	ND	ND	ND
75-27-4	VOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
75-25-2	VOCs		ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
74-83-9	VOCs		ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
75-15-0	VOCs	Carbon disulfide	ug/kg dw	3.3	0.813	11%				ND	ND	ND	ND	ND	ND
56-23-5	VOCs	[redacted]	ug/kg dw	ND	NC	ND				ND	ND	ND	ND	ND	ND
108-90-7	VOCs	Chlorobenzene	ug/kg dw	7200	1960	89%				ND	ND	ND	ND	ND	ND
75-00-3	VOCs	Chloroethane	ug/kg dw	1	0.729	11%				ND	ND	ND	ND	ND	ND
67-66-3	VOCs	Chloroform	ug/kg dw	9.7	1.6	11%				ND	ND	ND	ND	ND	ND
74-87-3	VOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
156-59-2	VOCs	cis-1,2-Dichloroethene	ug/kg dw	5.8	1.86	44%				ND	ND	ND	ND	ND	ND
10061-01-5	VOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
124-48-1	VOCs		ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
100-41-4	VOCs	Ethylbenzene	ug/kg dw	82	24.8	67%				ND	ND	ND	ND	ND	ND
108-38-3	VOCs	m&p-Xylene	ug/kg dw	630	122	67%				ND	ND	ND	ND	ND	ND
75-09-2	VOCs	Methylene chloride (Dichloromethane)	ug/kg dw	17	3.32	22%				ND	ND	ND	ND	ND	ND
100-42-5	VOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
127-18-4	VOCs	Tetrachloroethene	ug/kg dw	24	5.13	22%				ND	ND	ND	ND	ND	ND
108-88-3	VOCs	Toluene	ug/kg dw	7800	998	67%				1.8	1.1	2.2	5.6	3.08	6.16
156-60-5	VOCs	trans-1,2-Dichloroethene	ug/kg dw	0.91	0.619	11%				ND	ND	ND	ND	ND	ND
10061-02-6	VOCs	[redacted]	ug/kg dw	ND	ND	ND				ND	ND	ND	ND	ND	ND
79-01-6	VOCs	Trichloroethene	ug/kg dw	42	5.94	22%				ND	ND	ND	ND	ND	ND
75-01-4	VOCs	Vinyl chloride	ug/kg dw	4	0.988	22%				ND	ND	ND	ND	ND	ND
1330-20-7	VOCs	Xylenes, Total	ug/kg dw	710	142	67%				ND	ND	ND	ND	ND	ND

Notes
[1]Consensus-Based Threshold Effect Concentration - MacDonald, D D , C G Ingersoll, and T A Berger 2000 Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems *Arch Environ Contam Toxicol* 39 20-31
[2]Sediment Quality Assessment Guidelines - MacDonald Environmental Sciences, Ltd 1994 Approach to the Assessment of Sediment Quality in Florida Coastal Waters, Volume 1 – Development and Evaluation of Sediment Quality Assessment Guidelines Prepared for FLDEP November 1994
[3]Lowest Effect Level - Persaud, D , R Jaagumagi, and A Hayton 1993 Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario Ontario Ministry of Environment and Energy August 1993
*Ontario and Sediment Quality Guideline values are for 2,4'-DDT and 4,4'-DDT
**Florida, Ontario, and Sediment Quality Guideline values are for Chlordane
***No Effect Level for Heptachlor
[redacted]
Detected in reference samples but not at the Site
Average concentration is greater than the maximum concentration

Table 5-3

Whole Body Fish Tissue

Analytical Data Summary

Table 6-3 Whole Body Fish Tissue Screening Table
W G Krummrich Site
Sauget, Illinois

Channel Catfish, Drum, Shad Whole Body				Site			Downstream (DDA) Reference			Upstream (UDA) Reference		
CAS	Analysis	Name	Units	Site Maximum	Site Average	Frequency of Detection	Downstream Maximum	Downstream Average	2 X Downstream Average	Upstream Maximum	Upstream Average	2 X Upstream Average
% Lipids		% Lipids	%	17	9.667	100.00%	14	6.667	13.334	10	8.333	16.666
3268-87-9	Dioxin	1,2,3,4,6,7,8,9-OCDD	pg/g	189	29.64	100.00%	119	44.93	89.86	79.7	30.87	61.74
39001-02-0	Dioxin	1,2,3,4,6,7,8,9-OCDF	pg/g	4.3	0.6617	11.11%	2.7	0.9733	1.9466	ND	ND	ND
35822-46-9	Dioxin	1,2,3,4,6,7,8-HpCDD	pg/g	7.1	2.91	100.00%	4.3	3.073	6.146	8.8	4.12	8.24
67562-39-4	Dioxin	1,2,3,4,6,7,8-HpCDF	pg/g	1	0.1367	11.11%	ND	ND	ND	0.59	0.2167	0.4334
55673-89-7	Dioxin	[redacted]	pg/g	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
39227-28-6	Dioxin	1,2,3,4,7,8-HxCDD	pg/g	0.3	0.1411	44.44%	0.58	0.22	0.44	0.33	0.2217	0.4434
70648-26-9	Dioxin	1,2,3,4,7,8-HxCDF	pg/g	0.64	0.3511	55.56%	0.71	0.3217	0.6434	0.86	0.5933	1.1866
57653-85-7	Dioxin	1,2,3,6,7,8-HxCDD	pg/g	1.2	0.8467	100.00%	2	0.9033	1.8066	1.8	1.153	2.306
57117-44-9	Dioxin	1,2,3,6,7,8-HxCDF	pg/g	0.22	0.1067	44.44%	0.34	0.1333	0.2666	0.26	0.1633	0.3266
19408-74-3	Dioxin	1,2,3,7,8,9-HxCDD	pg/g	0.58	0.3989	100.00%	0.78	0.4133	0.8266	1.1	0.6033	1.2066
72918-21-9	Dioxin	[redacted]	pg/g	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
40321-76-4	Dioxin	1,2,3,7,8-PeCDD	pg/g	0.64	0.3326	77.78%	1.2	0.4883	0.9766	1	0.5467	1.0934
57117-41-6	Dioxin	1,2,3,7,8-PeCDF	pg/g	0.43	0.07389	11.11%	ND	ND	ND	ND	ND	ND
60851-34-5	Dioxin	2,3,4,6,7,8-HxCDF	pg/g	0.48	0.1933	66.67%	0.86	0.4133	0.8266	0.3	0.215	0.43
57117-31-4	Dioxin	2,3,4,7,8-PeCDF	pg/g	0.64	0.3161	77.78%	1	0.41	0.82	0.59	0.2883	0.5766
1746-01-6	Dioxin	2,3,7,8-TCDD	pg/g	2.4	0.5794	66.67%	0.96	0.4417	0.8834	1.1	0.6	1.2
51207-31-9	Dioxin	2,3,7,8-TCDF	pg/g	5.7	1.404	100.00%	1	0.62	1.24	2.6	1.317	2.634
37871-00-4	Dioxin	Total HpCDD	pg/g	13.5	4.011	100.00%	8.5	4.617	9.234	12.4	5.5	11
38998-75-3	Dioxin	Total HpCDF	pg/g	13.6	3.664	88.89%	8.5	5.633	11.266	4.5	3.2	6.4
34465-46-8	Dioxin	Total HxCDD	pg/g	3.3	2.072	77.78%	3.9	1.677	3.354	4.9	2.717	5.434
55684-94-1	Dioxin	Total HxCDF	pg/g	61.6	20.5	100.00%	42.1	30.9	61.8	21.2	19.5	39
36088-22-9	Dioxin	Total PeCDD	pg/g	7.5	2.969	100.00%	3.2	2.3	4.6	3	2.387	4.734
30402-15-4	Dioxin	Total PeCDF	pg/g	124	43.07	100.00%	93.9	60.2	120.4	125	74.07	148.14
41903-57-5	Dioxin	Total TCDD	pg/g	7.2	2.458	77.78%	1.4	0.6917	1.3834	1.5	0.9567	1.9134
55722-27-5	Dioxin	Total TCDF	pg/g	187	77.36	100.00%	216	124.7	249.4	121	90.73	181.46
93-76-5	Herbicides	2,4,5-T	ug/kg	13	5.74	33.33%	ND	ND	ND	7.1	5.13	10.26
93-72-1	Herbicides	2,4,5-TP (Silvex)	ug/kg	8.7	4.87	55.56%	6.9	4.96	9.96	7.5	5.27	10.54
94-75-7	Herbicides	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
94-82-6	Herbicides	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
75-99-0	Herbicides	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
1918-00-9	Herbicides	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	8.5	7.23	14.46
120-36-5	Herbicides	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
88-85-7	Herbicides	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
94-74-6	Herbicides	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
7085-19-0	Herbicides	MCPP[2-(4-chloro-2-methylphenoxy)-propanoic acid]	ug/kg	8600	2300	33.33%	ND	ND	ND	ND	ND	ND
87-86-5	Herbicides	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
2051-24-3	PCBs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
C-DICHLOROBI	PCBs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
C-HEPTACHLOR	PCBs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
C-HEXACHLORO	PCBs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
C-MONOCHLORO	PCBs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
C-NONACHLORO	PCBs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
C-OCTA-BIPHE	PCBs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
C-PENTBIPHEN	PCBs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
C-TETRACHLOR	PCBs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
C-TOTAL-PCB	PCBs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
C-TRICHLOROB	PCBs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
72-54-8	Pesticides	4,4'-DDD	ug/kg	8.7	11.2	22.22%	12	16.6	33	ND	ND	ND
72-55-9	Pesticides	4,4'-DDE	ug/kg	60	18.4	88.89%	19	13.4	26.8	25	21	42
50-29-3	Pesticides	4,4'-DDT	ug/kg	13	12.6	11.11%	ND	ND	ND	7.6	15	30
309-00-2	Pesticides	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
319-84-6	Pesticides	alpha-BHC	ug/kg	2.6	11.4	11.11%	ND	ND	ND	ND	ND	ND
5103-71-9	Pesticides	alpha-Chlordane	ug/kg	14	11.7	22.22%	7.7	10.9	21.8	ND	ND	ND
319-85-7	Pesticides	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
319-86-8	Pesticides	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
60-57-1	Pesticides	Dieldrin	ug/kg	64	14.9	77.78%	19	13.9	27.8	32	21.2	42.4
959-98-8	Pesticides	Endosulfan I	ug/kg	4.3	11.6	11.11%	ND	ND	ND	3	13.5	27
33213-65-9	Pesticides	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND

Table 6-3 Whole Body Fish Tissue Screening Table
W G Krummrich Site
Sauget, Illinois

CAS	Analysis	Name (Channel Catfish, Drum, Shad Whole Body)	Units	Site Maximum	Site Average	Frequency of Detection	Downstream (DDA) Reference: Downstream Maximum	Downstream Average	2 X Downstream Average	Upstream (UDA) Reference: Upstream Maximum	Upstream Average	2 X Upstream Average
% Lipids		% Lipids	%	17	9.667	100.00%	14	6.667	13.334	10	8.333	16.666
1031-07-8	Pesticides	[redacted]	ug/kg	ND	ND	0.00%	12	16.5	33	ND	ND	ND
72-20-8	Pesticides	Endrin	ug/kg	15	12.2	22.22%	ND	ND	ND	ND	ND	ND
7421-93-4	Pesticides	Endrin aldehyde	ug/kg	10	11.6	22.22%	4.9	14.1	28.2	7.4	12.5	25
53494-70-5	Pesticides	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
58-89-9	Pesticides	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
5103-74-2	Pesticides	gamma-Chlordane	ug/kg	6.1	11	22.22%	3.6	13.7	27.4	5.8	14.4	28.8
76-44-8	Pesticides	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
1024-57-3	Pesticides	Heptachlor epoxide	ug/kg	6.3	10.7	22.22%	ND	ND	ND	ND	ND	ND
72-43-5	Pesticides	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
8001-35-2	Pesticides	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
87-61-6	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
120-82-1	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
95-50-1	SVOCs	1,2-Dichlorobenzene	ug/kg	240	228	44.44%	ND	ND	ND	ND	ND	ND
108-70-3	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
541-73-1	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
106-46-7	SVOCs	1,4-Dichlorobenzene	ug/kg	130	241	11.11%	ND	ND	ND	ND	ND	ND
108-60-1	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
15950-66-0	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
933-78-8	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
933-7-5	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
95-95-4	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
88-06-2	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
120-83-2	SVOCs	2,4-Dichlorophenol	ug/kg	190	227	33.33%	ND	ND	ND	ND	ND	ND
105-67-9	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
51-28-5	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
121-14-2	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
606-20-2	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
91-58-7	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
95-57-8	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
91-57-6	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
95-48-7	SVOCs	2-Methylphenol (o-Cresol)	ug/kg	220	222	44.44%	340	317	634	110	207	414
88-74-4	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
88-75-5	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
91-94-1	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
609-19-8	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
106-44-5	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
99-09-2	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
534-52-1	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
101-55-3	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
59-50-7	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
106-47-8	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
7005-72-3	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
100-01-6	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
100-02-7	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
83-32-9	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
208-96-8	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
120-12-7	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
56-55-3	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
50-32-8	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
205-99-2	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
191-24-2	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
207-08-9	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
111-91-1	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
111-44-4	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
117-81-7	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
85-68-7	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
86-74-8	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND

Table 6-3 Whole Body Fish Tissue Screening Table
W G. Krummrich Site
Sauget, Illinois

Channel Catfish, Drum, Shad Whole Body				Site			Downstream (DDA) Reference			Upstream (UDA) Reference		
CAS	Analysis	Name	Units	Site Maximum	Site Average	Frequency of Detection	Downstream Maximum	Downstream Average	2 X Downstream Average	Upstream Maximum	Upstream Average	2 X Upstream Average
% Lipids		% Lipids	%	17	9.667	100.00%	14	6.667	13.334	10	8.333	16.666
218-01-9	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
84-74-2	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
117-84-0	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
53-70-3	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
132-64-9	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
84-66-2	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
131-11-3	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	110	207	414
206-44-0	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
86-73-7	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
118-74-1	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
87-68-3	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
77-47-4	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
67-72-1	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
193-39-5	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
78-59-1	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
621-64-7	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
86-30-6	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
91-20-3	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
98-95-3	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
87-86-5 (SVOC)	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
85-01-8	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
108-95-2	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND
129-00-0	SVOCs	[redacted]	ug/kg	ND	ND	0.00%	ND	ND	ND	ND	ND	ND

Not [redacted]
Site maximum concentration is less than the UDA and DDA maximum concentrations
Average concentration is greater than the maximum concentration

Table 5-4

Fish Tissue Analytical Data Comparison

Species and Area

Table 8-3 Fish Comparison Species-by-Species and by Area
W G Krummrich Site
Sauget, Illinois

Analysis	Compounds	Units	Channel Catfish Whole Body				Drum Whole Body				Gizzard Shad Whole Body				Big Mouth Buffalo Fillet			
			Site Average	Site Max	Upstream	Downstream	Site Average	Site Max	Upstream	Downstream	Site Average	Site Max	Upstream	Downstream	Site Average	Site Max	Upstream	Downstream
	% Lipids	%	7.67	10	9	14	6.33	13.00	10	3	15	17	8	3	1.87	2	4	2
Dioxin	1,2,3,4,6,7,8,9-OCDD	pg/g	9.1	10.9	8.1	11.3	9.533	18.50	4.8	4.5	70.3	189	79.7	119	3.6	5.6	7.5	2.8
Dioxin	1,2,3,4,6,7,8,9-OCDF	pg/g	ND	ND	ND	ND	ND	ND	ND	ND	1.566	4.3	ND	2.7	ND	ND	ND	ND
Dioxin	1,2,3,4,6,7,8-HpCDD	pg/g	3.7	4.1	2.8	4.3	1.583	2.50	0.78	0.62	3.467	7.1	8.8	4.3	0.6183	0.87	1.4	0.71
Dioxin	1,2,3,4,6,7,8-HpCDF	pg/g	ND	ND	ND	ND	ND	ND	ND	ND	0.3533	1	0.59	ND	ND	ND	ND	ND
Dioxin	1,2,3,4,7,8,9-HpCDF	pg/g	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dioxin	1,2,3,4,7,8-HxCDD	pg/g	0.2667	0.3	0.33	0.58	ND	ND	ND	ND	0.09	0.18	0.3	ND	ND	ND	ND	0.12
Dioxin	1,2,3,4,7,8-HxCDF	pg/g	0.2389	0.43	0.42	0.71	0.34	0.47	0.51	ND	0.475	0.84	0.66	ND	ND	ND	ND	ND
Dioxin	1,2,3,6,7,8-HxCDD	pg/g	1.133	1.2	1.3	2	0.6167	0.84	0.38	0.34	0.79	1.1	1.8	0.37	0.2367	0.26	0.82	0.31
Dioxin	1,2,3,6,7,8-HxCDF	pg/g	0.09167	0.17	0.19	0.34	0.145	0.22	0.28	ND	0.08333	0.19	ND	ND	ND	ND	ND	ND
Dioxin	1,2,3,7,8,9-HxCDD	pg/g	0.5033	0.58	0.51	0.78	0.3033	0.38	0.2	0.2	0.39	0.54	1.1	0.26	0.07333	0.14	0.25	ND
Dioxin	1,2,3,7,8,9-HxCDF	pg/g	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dioxin	1,2,3,7,8-PeCDD	pg/g	0.51	0.64	0.61	1.2	0.05833	0.10	ND	ND	0.43	0.51	1	0.24	0.1567	0.19	0.58	0.18
Dioxin	1,2,3,7,8-PeCDF	pg/g	ND	ND	ND	ND	ND	ND	ND	ND	0.175	0.43	ND	ND	ND	ND	ND	ND
Dioxin	2,3,4,6,7,8-HxCDF	pg/g	0.1483	0.22	0.27	0.88	0.1517	0.24	ND	0.2	0.28	0.48	0.3	0.18	ND	ND	0.16	ND
Dioxin	2,3,4,7,8-PeCDF	pg/g	0.5033	0.64	0.59	1	0.08167	0.13	ND	ND	0.3833	0.55	0.25	0.21	0.2067	0.24	0.79	0.22
Dioxin	2,3,7,8-TCDD	pg/g	0.6	0.63	0.53	0.98	ND	ND	0.17	ND	1.083	2.4	1.1	0.34	0.1667	0.26	3.3	0.3
Dioxin	2,3,7,8-TCDF	pg/g	0.6667	1.2	0.35	0.63	0.6767	1.30	1	0.33	2.84	5.7	2.6	1	0.6033	0.72	1.6	0.09
Dioxin	Total HpCDD	pg/g	3.9	4.3	3.1	4.6	2.233	3.60	1	0.75	5.9	13.5	12.4	8.5	0.755	1.1	1.7	0.81
Dioxin	Total HpCDF	pg/g	0.9917	2.1	2.2	5.3	3.267	8.10	2.9	8.5	6.733	13.8	4.5	3.1	0.65	0.9	2.4	0.8
Dioxin	Total HxCDD	pg/g	2.4	2.8	2.6	3.8	1.933	2.90	ND	ND	1.883	3.3	4.9	ND	ND	ND	2	ND
Dioxin	Total HxCDF	pg/g	10.43	15.3	18.9	42.1	16.67	27.00	18.4	38.5	34.2	81.8	21.2	12.1	3.333	4.8	11.6	4.8
Dioxin	Total PeCDD	pg/g	2.333	3.3	1.9	3.2	3.633	7.50	2.2	1.1	3	3.4	3	2.8	1.06	1.5	2.1	1.9
Dioxin	Total PeCDF	pg/g	31.67	41.8	47.8	93.9	35.3	43.20	49.4	82	82.33	124	125	24.7	8.433	13.4	27.6	12.2
Dioxin	Total TCDD	pg/g	0.8833	1.1	0.62	1.4	2.482	7.20	0.78	ND	4	5.9	1.6	0.61	1.177	2.1	3.7	0.72
Dioxin	Total TCDF	pg/g	70.5	106	121	216	63.3	79.30	84.2	128	98.27	187	87	30	16.3	23.7	46.3	22.5
Herbicides	2,4,5-T	ug/kg	4.87	8.3	ND	ND	8.22	13.00	7.1	ND	ND	ND	ND	ND	4.37	4.8	ND	ND
Herbicides	2,4,5-TP (Silvex)	ug/kg	4.07	3.9	ND	ND	4.62	8.40	7.5	8.9	5.92	8.7	ND	3.9	ND	ND	ND	ND
Herbicides	2,4-D	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Herbicides	2,4-DB	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Herbicides	Dalapon	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Herbicides	Dicamba	ug/kg	ND	ND	6.5	ND	ND	ND	5.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Herbicides	Dichloroprop	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Herbicides	Dinoseb	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Herbicides	MCPA[(4-chloro-2-methylphenoxy)-acetic acid]	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Herbicides	MCPP[2-(4-chloro-2-methylphenoxy)-propanoic acid]	ug/kg	4100	8600	ND	ND	ND	ND	ND	ND	1800	3400	ND	ND	ND	ND	ND	ND
Herbicides	Pentachlorophenol	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCBs	Decachlorobiphenyl	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCBs	Dichlorobiphenyl	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCBs	Heptachlorobiphenyl	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCBs	Hexachlorobiphenyl	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCBs	Monochlorobiphenyl	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCBs	Nonachlorobiphenyl	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCBs	Octachlorobiphenyl	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCBs	Pentachlorobiphenyl	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCBs	Tetrachlorobiphenyl	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCBs	Total Polychlorinated Biphenyls	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCBs	Trichlorobiphenyl	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pesticides	4,4'-DDD	ug/kg	ND	ND	ND	ND	8.6	8.70	ND	12	ND	ND	ND	ND	ND	ND	ND	ND
Pesticides	4,4'-DDE	ug/kg	20.3	26	ND	18	27	80.00	25	19	7.9	5.8	13	5.2	9.4	8.2	17	7.3
Pesticides	4,4'-DDT	ug/kg	ND	ND	ND	ND	12.7	13.00	7.8	ND	ND	ND	ND	ND	ND	ND	8.8	ND
Pesticides	Aldrin	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pesticides	alpha-BHC	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	9.2	2.8	ND	ND	ND	ND	ND	ND
Pesticides	alpha-Chlordane	ug/kg	9.6	3.8	ND	7.7	13	14.00	ND	ND	ND	ND	ND	ND	ND	ND	5.8	ND
Pesticides	beta-BHC	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pesticides	delta-BHC	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pesticides	Dieldrin	ug/kg	9.23	11	ND	18	25.8	84.00	32	8.8	9.77	4.3	6.7	14	ND	ND	8.1	ND
Pesticides	Endosulfan I	ug/kg	ND	ND	ND	ND	9.77	4.30	3	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pesticides	Endosulfan II	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pesticides	Endosulfan sulfate	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	12	ND	ND	ND	ND
Pesticides	Endrin	ug/kg	13.3	15	ND	ND	10.8	7.50	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pesticides	Endrin aldehyde	ug/kg	10.5	8.4	ND	ND	11.7	10.00	7.4	4.9	ND	ND	5.1	ND	ND	ND	7.3	ND
Pesticides	Endrin ketone	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pesticides	gamma-BHC (Lindane)	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.2	ND
Pesticides	gamma-Chlordane	ug/kg	9.47	3.4	ND	ND	11	8.10	5.8	3.5	ND	ND	ND	ND	ND	ND	5.2	ND
Pesticides	Heptachlor	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pesticides	Heptachlor epoxide	ug/kg	9.47	3.4	ND	ND	10.1	5.30	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pesticides	Methoxychlor	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	48	44	ND	ND
Pesticides	Toxaphene	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	1,2,3-Trichlorobenzene	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	1,2,4-Trichlorobenzene	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	1,2-Dichlorobenzene	ug/kg	240	210	ND	ND	ND	ND	ND	ND	190	240	ND	ND	ND	ND	ND	ND
SVOCs	1,3,5-Trichlorobenzene	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table 6-3 Fish Comparison - Species-by-Species and by Area
W G Krummrich Site
Sauget, Illinois

Analysis	Compounds	Units	Channel Catfish Whole Body Site Average	Channel Catfish Whole Body Site Max	Channel Catfish Whole Body Upstream	Channel Catfish Whole Body Downstream	Drum Whole Body Site Average	Drum Whole Body Site Max	Drum Whole Body Upstream	Drum Whole Body Downstream	Gizzard Shad Whole Body Site Average	Gizzard Shad Whole Body Site Max	Gizzard Shad Whole Body Upstream	Gizzard Shad Whole Body Downstream	Big Mouth Buffalo Fillet Site Average	Big Mouth Buffalo Fillet Site Max	Big Mouth Buffalo Fillet Upstream	Big Mouth Buffalo Fillet Downstream
SVOCs	1,3-Dichlorobenzene	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	1,4-Dichlorobenzene	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	213	130	ND	ND	ND	ND	ND	ND
SVOCs	2,2'-Oxybis(1-Chloropropane) (bis-2-chloroisopropyl ether)	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	2,3,4-Trichlorophenol	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	2,3,5-Trichlorophenol	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	2,3,6-Trichlorophenol	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	2,4,5-Trichlorophenol	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	2,4,6-Trichlorophenol	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	2,4-Dichlorophenol	ug/kg	233	180	ND	ND	ND	ND	ND	ND	192	180	ND	ND	ND	ND	ND	ND
SVOCs	2,4-Dimethylphenol	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	2,4-Dinitrophenol	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	2,4-Dinitrotoluene	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	2,6-Dinitrotoluene	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	2-Chloronaphthalene	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	2-Chlorophenol	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	2-Methylnaphthalene	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	2-Methylphenol (o-Cresol)	ug/kg	230	180	ND	340	218	220.00	ND	280	217	140	110	320	ND	ND	ND	ND
SVOCs	2-Nitroaniline	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	2-Nitrophenol	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	3,3'-Dichlorobenzidine	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	3,4,5-Trichlorophenol	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	3-Methylphenol/4-Methylphenol (m&p-Cresol)	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	3-Nitroaniline	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	4,6-Dinitro-2-methylphenol	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	4-Bromophenylphenyl ether	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	4-Chloro-3-methylphenol	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	4-Chloroaniline	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	4-Chlorophenylphenyl ether	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	4-Nitroaniline	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	4-Nitrophenol	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	Acenaphthene	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	Acenaphthylene	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	Anthracene	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	Benzo(a)anthracene	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	Benzo(a)pyrene	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	Benzo(b)fluoranthene	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	Benzo(g,h,i)perylene	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	Benzo(k)fluoranthene	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	bis(2-Chloroethoxy)methane	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	bis(2-Chloroethyl)ether	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	bis(2-Ethylhexyl)phthalate	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	Butylbenzylphthalate	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	Carbazole	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	Chrysene	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	Di-n-butylphthalate	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	Di-n-octylphthalate	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	Dibenzo(a,h)anthracene	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	Dibenzofuran	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	Diethylphthalate	ug/kg	ND	ND	ND	ND	ND	ND	ND	110	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	Dimethylphthalate	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	Fluoranthene	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	Fluorene	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	Hexachlorobenzene	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	Hexachlorobutadiene	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	Hexachlorocyclopentadiene	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	Hexachloroethane	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	Indeno(1,2,3-cd)pyrene	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	Isophorone	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	N-Nitroso-di-n-propylamine	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	N-Nitrosodiphenylamine	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	Naphthalene	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	Nitrobenzene	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	Phenanthrene	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	Phenol	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs	Pyrene	ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table 5-5

Surface Water and Sediment Toxicity

Data Summary

Table 8-5
Toxicity Test Summary
WGK Plant Ecological Risk Assessment
Sauget, Illinois

STATION	SEDIMENT[1]				SURFACE WATER[2]					
	Amphipod 28-d Chronic Sediment Bioassay		Fathead Minnow 7-d Chronic Sediment Bioassay		Fathead Minnow Surface Water Bioassay			Ceriodaphnia Surface Water Bioassay		
	Survival	Growth	Survival	Growth	Acute 2d Survival	Chronic 7d Survival	Chronic 7d Growth	Acute 2d Survival	Chronic 7d Survival	Chronic 7d Reproduction
UDA-11	No	No	No	No	No	No	No	No	No	No
UDA-12	No	No	No	No	No	No	No	No	No	No
PDA-8	No	No	No	No	No	No	No	No	No	Yes
PDA-8 FD					No	No	No	No	No	No
PDA-9	No	No	Yes	Yes*	No	No	No	No	No	Yes
PDA-10	No	No	No	No	No	No	No	No	No	No
PDA-5	Yes	Yes*	Yes[3]	Yes*	No	No	No	No	No	Yes
PDA-6	No	No	No	No	No	No	No	No	No	No
PDA-7	No	No	No	No	No	No	No	No	No	No
PDA-2	No	No	No	No	No	No	No	Yes[3]	Yes[3]	Yes*
PDA-2 FD					No	No	No	Yes[3]	Yes[3]	Yes*
PDA-3	No	No	Yes	Yes*	No	No	No	Yes	Yes	Yes*
PDA-3 FD	No	No	Yes	Yes*						
PDA-4	No	No	No	No	No	No	No	Yes	Yes	Yes*
DDA-13	No	No	No	No	Yes	Yes	Yes*	No	No	No
DDA-1	No	No	No	No	No	Yes	Yes*	No	No	No

[1] "Yes" indicates a statistically significant reduction in the organism response when compared to the control group

[2] "Yes" indicates a statistically significant reduction in the organism response when compared to one or more of the control groups

[3] 0% survival in this sample

*Samples with effects on survival were excluded from statistical analysis of the more sensitive endpoint (growth or reproduction); it is assumed that the more sensitive endpoint is affected if survival is affected.

Table 5-6

Summary of Benthic Invertebrate Community Data

Table 8-7 Summary of Benthic Invertebrate Community Data
W G Krummrich Plant Ecological Risk Assessment
Sauget, Illinois

<50' from shore, Upstream Reference, Sandy Sediment	UDA-11 A	UDA-11 B	UDA-11 C
# Organisms	0	8	7
# Taxa	0	1	2
Dominant Taxa	NA	Chironomidae (Paratendipes basidens)	Chironomidae (Paratendipes basidens)
2nd Dominant Taxa	NA	NA	Pelecypoda (Pisidium sp)
30' from shore, Upstream Reference, Soft Sediment	UDA-12 A	UDA-12 B	UDA-12 C
# Organisms	4	0	7
# Taxa	3	0	3
Dominant Taxa	Ephemeroptera (Hexagenia limbata)	NA	Chironomidae (Cryptochironomus fulvus)
2nd Dominant Taxa	Chironomidae	NA	Oligochaeta (Limnodrilus claparedianus)
50' from Shore, Soft Sediment	PDA-2 A	PDA-2 B	PDA-2 C
# Organisms	1	0	6
# Taxa	1	0	2
Dominant Taxa	Chironomidae	NA	Trichoptera (Potamyia flava)
2nd Dominant Taxa	NA	NA	Chironomidae (Cryptochironomus fulvus)
300' from Shore, Sandy Sediment	PDA-7 A	PDA-7 B	PDA-7 C
# Organisms	2	0	1
# Taxa	2	0	1
Dominant Taxa	Chironomidae (Chernovskiia sp /Paratendipes basidens)	NA	Chironomidae (Paratendipes basidens)
2nd Dominant Taxa	NA	NA	NA
50' from Shore, Soft Sediment	PDA-8 A	PDA-8 B	PDA-8 C
# Organisms	1	2	0
# Taxa	1	2	0
Dominant Taxa	Pelecypoda (Pisidium sp)	Chironomidae/Pelecypoda	NA
2nd Dominant Taxa	NA	NA	NA
65' from shore, Downstream Reference, Soft Sediment	DDA-1 A	DDA-1 B	DDA-1 C
# Organisms	62	54	32
# Taxa	8	6	6
Dominant Taxa	Oligochaeta (Limnodrilus claparedianus)	Oligochaeta (Limnodrilus claparedianus)	Chironomidae (Chironomus decorus)
2nd Dominant Taxa	Chironomidae (Chironomus decorus)	Chironomidae (Chironomus decorus)	Oligochaeta (Limnodrilus claparedianus)
Downstream Reference, Sandy Sediment	DDA-13 A	DDA-13 B	DDA-13 C
# Organisms	1	7	10
# Taxa	1	2	2
Dominant Taxa	Chironomidae (Chernovskiia sp)	Chironomidae (Paratendipes basidens)	Chironomidae (Paratendipes basidens)
2nd Dominant Taxa	NA	Trichoptera (Potamyia flava)	Pelecypoda (Pisidium sp)

Table 5-7

EPA Sediment Sampling Data

EPA Sediment Data Summary
Constituent Concentrations at All Sampling Stations
with Detected Concentrations

Constituent Concentration, (ppb)	**PDA 2-60**	**MR-SD 2-150**	**MR-SD 4-90**	**PDA 5R-60**	**MR-SD 5-75**	**MR-SD 5-150**	**MR-SD 5-315**	**MR-SD 7-150**
				Sampling Station				
Benzene	ND	55	4.2	ND	45	58	260	36
Chlorobenzene	10,000	390	100	450	1,800	6,700	3,100	1600
1,2-Dichloroethane	ND	ND	ND	110	ND	ND	ND	ND
Ethylbenzene	ND	ND	2	ND	ND	ND	ND	ND
Toluene	12,000	ND	ND	140	ND	ND	ND	ND
Xylenes	ND	ND	2.6	120	ND	ND	ND	ND
Aniline	210	ND	ND	3,900	2,400	3,400	ND	ND
4-Chloroaniline	720	99	ND	3,300	3,000	6,400	ND	58
1,4-Dichlorobenzene	390	ND	ND	ND	300	1,700	ND	ND
Phenol	ND	ND	ND	3,200	ND	ND	ND	ND
2-Chlorophenol	ND	ND	ND	400	ND	ND	ND	ND
2,4-Dichlorophenol	ND	ND	ND	610	ND	ND	ND	ND
3-Methylphenol	95	ND	ND	ND	ND	ND	ND	ND
PCBs	ND	ND	ND	ND	ND	120	38	20
TOC	11,000	ND	ND	390	200	7,400	ND	ND

TABLE 1

VALIDATED ANALYTICAL RESULTS FOR SOLUTIA INC. SPLIT SAMPLES

Sample Identification	PDA-2-60	PDA-5-R-60	PDA-8-60
Date Collected	October 25, 2000	October 24, 2000	October 26, 2000
Volatile Organic Compounds (micrograms per kilogram [µg/kg])			
Acetone	5,800 U	3,300U	1,400 U
Benzene	1,100 U	260 U	3.40 U
Chlorobenzene	10,000	450	700
1,2-Dichloroethane	1,100 U	110 J	41 J
Methylene chloride	1,100 U	260 U	340 U
Toluene	12,000	140 J	340 U
Xylenes (total)	1,100 U	120 J	340 U
Semivolatile Organic Compounds (µg/kg)			
Aniline	210 J	3,900 J	410 U
4-Chloroaniline	720	3,300	410 U
2-Chlorophenol	580 U	400 J	410 U
1,2-Dichlorobenzene	120 J	780 U	410 U
1,4-Dichlorobenzene	390 J	780 U	410 U
2,4-Dichlorophenol	580 U	610 J	410 U
3-Methylphenol	95 J	780 U	410 U
Phenol	580 U	3,200 J	410 U
2,4,6-Trichlorophenol	580 U	780 U	410 U
2,6-Dichlorophenol	580 U	780 U	410 U
Organochlorine Pesticides (µg/kg)			
Aldrin	6.0 U	4.0 U	2.1 U
alpha-BHC	6.0 U	4.0 U	2.1 U
beta-BHC	6.0 U	4.0 U	2.1 U
delta-BHC	6.0 U	44 J	5.1 J
gamma-BHC (lindane)	6.0 U	4.0 U	2.1 U
Chlordane (technical)	60 U	40 U	21 U
Chlorobenzilate	120 U	21 J	41 U
4,4-DDD	6.0 U	14	2.1 U
4,4-DDE	6.0 U	4.0 U	2.1 U
4,4-DDT	6.0 U	4.0 U	2.1 U
Diallate	120 U	78 U	41 U
Dieldrin	6.0 U	4.0 U	2.1 U

TABLE 1 (continued)

VALIDATED ANALYTICAL RESULTS FOR SOLUTIA INC. SPLIT SAMPLES

Sample Identification	PDA-2-60	PDA-5-R-60	PDA-8-60
Date Collected	October 25, 2000	October 24, 2000	October 26, 2000
Organochlorine Pesticides (µg/kg) (Continued)			
Endosulfan I	6.0 U	4.0 U	2.1 U
Endosulfan II	6.0 U	4.0 U	2.1 U
Endosulfan sulfate	6.0 U	4.0 U	2.1 U
Endrin	6.0 U	4.0 U	2.1 U
Endrin aldehyde	6.0 U	4.0 U	2.1 U
Heptachlor	6.0 U	4.0 U	2.1 U
Heptachlor epoxide	6.0 U	4.0 U	2.1 U
Isodrin	12 U	7.8 U	4.1 U
Kepone	120 U	78 U	41 U
Methoxychlor	12 U	7.8 U	4.1 U
Toxaphene	230 U	160 U	83 U
Polychlorinated Biphenyls (PCB) (µg/kg)			
Aroclor 1016	58 U	39 U	41 U
Aroclor 1221	58 U	39 U	41 U
Aroclor 1232	58 U	39 U	41 U
Aroclor 1242	58 U	39 U	41 U
Aroclor 1248	58 U	84 J	41 U
Aroclor 1254	58 U	39 U	41 U
Aroclor 1260	58 U	39 U	41 U
Herbicides (µg/kg)			
2,4-D	140 U	790	99 U
2,4,5-TP (Silvex)	35 U	24 U	25 U
2,4,5-T	35 U	24 U	25 U
Organophosphorus Pesticides (µg/kg)			
Dimethoate	1,200 U	39 U	41 U
Disulfoton	1,200 U	39 U	41 U
Famphur	1,200 U	39 U	41 U
Methyl parathion	1,200 U	39 U	41 U
Phorate	1,200 U	39 U	41 U
Tetraethyldithiopyrophosphate	1,200 U	39 U	41 U
Thionazin	1,200 U	39 U	41 U
o,o,o-Triethylphosphorothioate	1,200 U	39 U	41 U

TABLE 1 (continued)

VALIDATED ANALYTICAL RESULTS FOR SOLUTIA INC. SPLIT SAMPLES

Sample Identification	PDA-2-60	PDA-5-R-60	PDA-8-60
Date Collected	October 25, 2000	October 24, 2000	October 26, 2000
General Chemistry (milligram per kilogram)			
Total organic carbon	11,000	390	510

Notes:

J = The result was estimated for quality control reasons.
U = The analyte was not detected; the numerical value is the sample reporting limit.
UJ = The analyte was not detected; the sample reporting limit is estimated for quality control reasons.

TABLE 2

VALIDATED ANALYTICAL RESULTS FOR SOLUTIA INC. SEDIMENT SAMPLES

Sample Identification	MR-SD-1-50	MR-SD-1-150	MR-SD-1-300	MR-SD-2-50	MR-SD-2-150
Date Collected	Nc[illegible]ber 1, 2000				
Volatile Organic Compounds (micrograms per kilogram [µg/kg])					
Acetone	22 U	22 U	26 U	24 U	1,300 U
Benzene	5.5 U	5.4 U	6.4 U	5.9 U	55 J
Chlorobenzene	5.5 U	5.4 U	6.4 U	6.5	390
Chloroform	5.5 U	5.4 U	6.4 U	5.9 U	300 U
Ethylbenzene	5.5 U	5.4 U	6.4 U	5.9 U	300 U
Methylene chloride	5.5 U	5.4 U	6.4 U	5.9 U	300 U
Xylenes (total)	5.5 U	5.4 U	6.4 U	5.9 U	300 U
Semivolatile Organic Compounds (µg/kg)					
Aniline	400 U	390 U	390 U	400 U	400 U
bis(2-Ethylhexyl)phthalate	400 U	390 U	390 U	400 U	400 U
4-Chloroaniline	400 U	390 U	390 U	400 U	99 J
1,2-Dichlorobenzene	400 U	390 U	390 U	400 U	400 U
1,3-Dichlorobenzene	400 U	390 U	390 U	400 U	400 U
1,4-Dichlorobenzene	400 U	390 U	390 U	400 U	400 U
Organochlorine Pesticides (µg/kg)					
Aldrin	2.0 U	2.0 U	2.0 U	2.1 U	2.0 U
alpha-BHC	2.0 U	2.0 U	2.0 U	2.1 U	2.0 U
beta-BHC	2.0 U	2.0 U	2.0 U	2.1 U	2.0 U
delta-BHC	2.0 U	2.0 U	2.0 U	2.1 U	2.0 U
gamma-BHC (lindane)	2.0 U	2.0 U	2.0 U	2.1 U	2.0 U
Chlordane (technical)	20 U	20 U	20 U	21 U	20 U
Chlorobenzilate	40 U	39 U	39 U	40 U	40 U
4,4-DDD	2.0 U	2.0 U	2.0 U	2.1 U	2.0 U
4,4-DDE	2.0 U	2.0 U	2.0 U	2.1 U	2.0 U
4,4-DDT	2.0 U	2.0 U	2.0 U	2.1 U	2.0 U
Diallate	40 U	39 U	39 U	40 U	40 U
Dieldrin	2.0 U	2.0 U	2.0 U	2.1 U	2.0 U
Endosulfan I	2.0 U	2.0 U	2.0 U	2.1 U	2.0 U
Endosulfan II	2.0 U	2.0 U	2.0 U	2.1 U	2.0 U
Endosulfan sulfate	2.0 U	2.0 U	2.0 U	2.1 U	2.0 U

TABLE 2 (Continued)

VALIDATED ANALYTICAL RESULTS FOR SOLUTIA, INC. SEDIMENT SAMPLES

Sample Identification	MR-SD-1-50	MR-SD-1-150	MR-SD-1-300	MR-SD-2-50	MR-SD-2-150
Date Collected	November 1, 2000				
Organochlorine Pesticides (µg/kg) (Continued)					
Endrin	2.0 U	2.0 U	2.0 U	2.1 U	2.0 U
Endrin aldehyde	2.0 U	2.0 U	2.0 U	2.1 U	2.0 U
Heptachlor	2.0 U	2.0 U	2.0 U	2.1 U	2.0 U
Heptachlor epoxide	2.0 U	2.0 U	2.0 U	2.1 U	2.0 U
Isodrin	4.0 U	3.9 U	3.9 U	4.0 U	4.0 U
Kepone	40 U	39 U	39 U	40 U	40 U
Methoxychlor	4.0 U	3.9 U	3.9 U	4.0 U	4.0 U
Toxaphene	80 U	80 U	79 U	81 U	81 U
Polychlorinated Biphenyls (PCB) (µg/kg)					
Aroclor 1016	40 U	39 U	39 U	40 U	40 U
Aroclor 1221	40 U	39 U	39 U	40 U	40 U
Aroclor 1232	40 U	39 U	39 U	40 U	40 U
Aroclor 1242	40 U	39 U	39 U	40 U	40 U
Aroclor 1248	40 U	39 U	39 U	40 U	40 U
Aroclor 1254	40 U	39 U	39 U	40 U	40 U
Aroclor 1260	40 U	39 U	39 U	40 U	40 U
Herbicides (µg/kg)					
2,4-D	96 U	95 U	94 U	97 U	96 U
2,4,5-TP (Silvex)	24 U	24 U	24 U	24 U	24 U
2,4,5-T	24 U	24 U	24 U	24 U	24 U
Organophosphorus Pesticides (µg/kg)					
Dimethoate	40 U	39 U	39 U	40 U	40 U
Disulfoton	40 U	39 U	39 U	40 U	40 U
Famphur	40 U	39 U	39 U	40 U	40 U
Methyl parathion	40 U	39 U	39 U	40 U	40 U
Phorate	40 U	39 U	39 U	40 U	40 U
Tetraethyldithiopyrophosphate	40 U	39 U	39 U	40 U	40 U
Thionazin	40 U	39 U	39 U	40 U	40 U
o,o,o-Triethylphosphorothioate	40 U	39 U	39 U	40 U	40 U
General Chemistry (milligram per kilogram)					
Total organic carbon	120 U	120 U	120 U	120 U	120 U

TABLE 2 (Continued)

VALIDATED ANALYTICAL RESULTS FOR SOLUTIA, INC. SEDIMENT SAMPLES

Sample Identification	MR-SD-2-330	MR-SD-3-25*	MR-SD-3-99	MR-SD-4-90	MR-SD-POP-90
Date Collected	November 1, 2000	November 2, 2000			
Volatile Organic Compounds (micrograms per kilogram [µg/kg])					
Acetone	21 U	30 U	160 U	26 U	28 U
Benzene	5 3 U	7 5 U	16 U	4.2 J	7 1 U
Chlorobenzene	5 3 U	7 5 U	3.3 J	100 J	7.1 U
Chloroform	5 3 U	7 5 U	16 U	6.5 U	7.1 U
Ethylbenzene	5.3 U	7.5 U	16 U	2.0 J	7.1 U
Methylene chloride	5.3 U	7.5 U	16 U	6.5 U	7 1 U
Xylenes (total)	5.3 U	7 5 U	16 U	2.6 J	7.1 U
Semivolatile Organic Compounds (µg/kg)					
Aniline	380 U	440	220 J	400 U	410 U
bis(2-Ethylhexyl)phthalate	380 U	390 U	390 U	400 U	410 U
4-Chloroaniline	380 U	390 U	130 J	400 U	410 U
1,2-Dichlorobenzene	380 U	390 U	390 U	400 U	410 U
1,3-Dichlorobenzene	380 U	390 U	390 U	400 U	410 U
1,4-Dichlorobenzene	380 U	390 U	390 U	400 U	410 U
Organochlorine Pesticides (µg/kg)					
Aldrin	2 0 U	2 0 U	2 0 U	4.1 U	2.1 U
alpha-BHC	2 0 U	2 0 U	2 0 U	4.1 U	2.1 U
beta-BHC	2 0 U	2 0 U	2 0 U	4 1 U	2.1 U
delta-BHC	2 0 U	2 0 U	2 0 U	3 7 J	2.1 U
gamma-BHC (lindane)	2 0 U	2 0 U	2 0 U	4 1 U	2 1 U
Chlordane (technical)	20 U	20 U	20 U	41 U	21 U
Chlorobenzilate	38 U	39 U	39 U	79 U	41 U
4,4-DDD	2 0 U	2 0 U	2 0 U	4 1 U	2 1 U
4,4-DDE	2 0 U	2 0 U	2 0 U	4.1 U	2.1 U
4,4-DDT	2 0 U	2 0 U	2 0 U	4 1 U	2 1 U
Diallate	38 U	39 U	39 U	79 U	41 U
Dieldrin	2 0 U	2 0 U	2 0 U	4.1 U	2 1 U
Endosulfan I	2 0 U	2 0 U	2 0 U	4.1 U	2 1 U
Endosulfan II	2 0 U	2 0 U	2 0 U	4 1 U	2 1 U
Endosulfan sulfate	2 0 U	2 0 U	2 0 U	4 1 U	2 1 U

TABLE 2 (Continued)

VALIDATED ANALYTICAL RESULTS FOR SOLUTIA, INC. SEDIMENT SAMPLES

Sample Identification	MR-SD-2-330	MR-SD-3-25ª	MR-SD-3-99	MR-SD-4-90	MR-SD-POP-90
Date Collected	**November 1, 2000**	**November 2, 2000**			
Organochlorine Pesticides (µg/kg) (Continued)					
Endrin	2.0 U	2.0 U	2.0 U	4.1 U	2.1 U
Endrin aldehyde	2.0 U	2.0 U	2.0 U	4.1 U	2.1 U
Heptachlor	2.0 U	2.0 U	2.0 U	4.1 UJ	2.1 U
Heptachlor epoxide	2.0 U	2.0 U	2.0 U	4.1 U	2.1 U
Isodrin	3.8 U	3.9 U	3.9 U	7.9 U	4.1 U
Kepone	38 U	39 U	39 U	79 U	41 U
Methoxychlor	3.8 U	3.9 U	3.9 U	3.4 J	4.1 U
Toxaphene	78 U	80 U	80 U	160 U	84 U
Polychlorinated Biphenyls (PCB) (µg/kg)					
Aroclor 1016	38 U	39 U	39 U	40 U	41 U
Aroclor 1221	38 U	39 U	39 U	40 U	41 U
Aroclor 1232	38 U	39 U	39 U	40 U	41 U
Aroclor 1242	38 U	39 U	39 U	40 U	41 U
Aroclor 1248	38 U	39 U	39 U	40 U	41 U
Aroclor 1254	38 U	39 U	39 U	40 U	41 U
Aroclor 1260	38 U	39 U	39 U	40 U	41 U
Herbicides (µg/kg)					
2,4-D	93 U	96 U	95 U	96 U	100 U
2,4,5-TP (Silvex)	23 U	24 U	24 U	24 U	25 U
2,4,5-T	23 U	24 U	24 U	24 U	25 U
Organophosphorus Pesticides (µg/kg)					
Dimethoate	38 U	39 UJ	39 UJ	40 UJ	41 UJ
Disulfoton	38 U	39 UJ	39 UJ	40 UJ	41 UJ
Famphur	38 U	39 U	39 U	40 UJ	41 U
Methyl parathion	38 U	39 UJ	39 UJ	40 UJ	41 UJ
Phorate	38 U	39 UJ	39 UJ	40 UJ	41 UJ
Tetraethyldithiopyrophosphate	38 U	39 U	39 U	40 UJ	41 U
Thionazin	38 U	39 U	39 U	40 UJ	41 U
o,o,o-Triethylphosphorothioate	38 U	39 U	39 U	40 UJ	41 U
General Chemistry (milligram per kilogram)					
Total organic carbon	120 U	120 U	120 U	120 U	130 U

TABLE 2 (Continued)

VALIDATED ANALYTICAL RESULTS FOR SOLUTIA, INC. SEDIMENT SAMPLES

Sample Identification	MR-SD-5-75	MR-SD-5-150	MR-SD-5-315	MR-SD-6-25[b]	MR-SD-6-90
Date Collected	November 3, 2000				
Volatile Organic Compounds (micrograms per kilogram [µg/kg])					
Acetone	1,300 U	2,500 U	1,300 U	24 U	35 U
Benzene	45 J	58 J	260 U	9.0	0.72 J
Chlorobenzene	1,800	6,700	3,100	82	8.0
Chloroform	370 U	320 U	260 U	6.0 U	5.6 U
Ethylbenzene	370 U	320 U	260 U	6.0 U	5.6 U
Methylene chloride	370 U	320 U	260 U	6.1 U	5.6 U
Xylenes (total)	370 U	320 U	260 U	6.0 U	5.6 U
Semivolatile Organic Compounds (µg/kg)					
Aniline	2,400	3,400	380 U	400 U	400 U
bis(2-Ethylhexyl)phthalate	430 U	430 U	380 U	93 J	400 U
4-Chloroaniline	3,000 J	6,400 J	380 U	400 U	400 U
1,2-Dichlorobenzene	430 U	430 U	380 U	190 J	55 J
1,3-Dichlorobenzene	430 U	430 U	380 U	150 J	400 U
1,4-Dichlorobenzene	300 J	1,700	380 U	330 J	51 J
Organochlorine Pesticides (µg/kg)					
Aldrin	2.2 U	11 U	1.9 U	2.0 U	2.0 U
alpha-BHC	2.2 U	11 U	1.9 U	2.0 U	2.0 U
beta-BHC	2.2 U	11 U	1.9 U	2.0 U	2.0 U
delta-BHC	2.2 U	11 U	1.9 U	2.0 U	2.0 U
gamma-BHC (lindane)	2.2 U	11 U	1.9 U	2.0 U	2.0 U
Chlordane (technical)	22 U	110 U	19 U	20 U	20 U
Chlorobenzilate	43 U	220 U	38 U	40 U	40 U
4,4-DDD	2.2 U	11 U	1.9 U	2.0 U	2.0 U
4,4-DDE	2.2 U	11 U	1.9 U	2.0 U	2.0 U
4,4-DDT	2.2 U	11 U	1.9 U	2.0 U	2.0 U
Diallate	43 U	220 U	38 U	40 U	40 U
Dieldrin	2.2 U	11 U	1.9 U	2.0 U	2.0 U
Endosulfan I	2.2 U	11 U	1.9 U	2.0 U	2.0 U
Endosulfan II	2.2 U	11 U	1.9 U	2.0 U	2.0 U
Endosulfan sulfate	2.2 U	11 U	1.9 U	2.0 U	2.0 U

TABLE 2 (Continued)

VALIDATED ANALYTICAL RESULTS FOR SOLUTIA, INC. SEDIMENT SAMPLES

Sample Identification	MR-SD-5-75	MR-SD-5-150	MR-SD-5-315	MR-SD-6-25[b]	MR-SD-6-90
Date Collected	November 3, 2000				
Organochlorine Pesticides (µg/kg) (Continued)					
Endrin	2.2 U	11 U	1.9 U	2.0 U	2.0 U
Endrin aldehyde	2.2 U	11 U	1.9 U	2.0 U	2.0 U
Heptachlor	2.2 U	11 U	1.9 U	2.0 U	2.0 U
Heptachlor epoxide	2.2 U	11 U	1.9 U	2.0 U	2.0 U
Isodrin	4.3 U	22 U	3.8 U	4.0 U	4.0 U
Kepone	43 U	220 U	38 U	40 U	40 U
Methoxychlor	4.3 U	22 U	3.8 U	4.0 U	4.0 U
Toxaphene	88 U	440 U	77 U	81 U	80 U
Polychlorinated Biphenyls (PCB) (µg/kg)					
Aroclor 1016	43 U	120 J	38 U	40 U	40 U
Aroclor 1221	43 U	43 U	38 U	40 U	40 U
Aroclor 1232	43 U	43 U	38 U	40 U	40 U
Aroclor 1242	43 U	43 U	38 U	40 U	40 U
Aroclor 1248	43 U	43 U	38 U	40 U	31 J
Aroclor 1254	43 U	43 U	38 U	40 U	40 U
Aroclor 1260	43 U	43 U	38 U	40 U	40 U
Organochlorine Herbicides (µg/kg)					
2,4-D	100 U	100 U	92 U	96 U	96 U
2,4,5-TP (Silvex)	26 U	26 U	23 U	24 U	24 U
2,4,5-T	26 U	26 U	23 U	24 U	24 U
Organophosphorus Pesticides (µg/kg)					
Dimethoate	43 U	43 U	38 U	40 U	40 U
Disulfoton	43 U	43 U	38 U	40 U	40 U
Famphur	43 U	43 U	38 U	40 U	40 U
Methyl parathion	43 U	43 U	38 U	40 U	40 U
Phorate	43 U	43 U	38 U	40 U	40 U
Tetraethyldithiopyrophosphate	43 U	43 U	38 U	40 U	40 U
Thionazin	43 U	43 U	38 U	40 U	40 U
o,o,o-Triethylphosphorothioate	43 U	43 U	38 U	40 U	40 U
General Chemistry (milligram per kilogram)					
Total organic carbon	200	7,400	110 U	870	1,100

TABLE 2 (Continued)

VALIDATED ANALYTICAL RESULTS FOR SOLUTIA, INC. SEDIMENT SAMPLES

Sample Identification	MR-SD-7-45	MR-SD-7-150	MR-SD-7-280	MR-SD-8-57	MR-SD-9-51
Date Collected	November 3, 2000			October 27, 2000	
Volatile Organic Compounds (micrograms per kilogram [µg/kg])					
Acetone	35 U	1,600 U	22 U	75 U	120 U
Benzene	5.7 U	36 J	5.5 U	6.0 U	6.8 U
Chlorobenzene	2.2 U	1,600	5.5 U	6.0 U	1.6 J
Chloroform	5.7 U	270 U	5.5 U	6.0 U	6.8 U
Ethylbenzene	5.7 U	270 U	5.5 U	6.0 U	6.8 U
Methylene chloride	5.7 U	270 U	5.5 U	6.0 U	6.8 U
Xylenes (total)	5.7 U	270 U	5.5 U	6.0 U	6.8 U
Semivolatile Organic Compounds (µg/kg)					
Aniline	400 U	390 U	390 U	390 U	420 U
bis(2-Ethylhexyl)phthalate	400 U	390 U	390 U	390 U	420 U
4-Chloroaniline	400 U	58 J	390 U	390 U	420 U
1,2-Dichlorobenzene	400 U	390 U	390 U	390 U	420 U
1,3-Dichlorobenzene	400 U	390 U	390 U	390 U	420 U
1,4-Dichlorobenzene	400 U	390 U	390 U	390 U	420 U
Organochlorine Pesticides (µg/kg)					
Aldrin	2.1 U	2.0 U	2.0 U	2.0 U	11 U
alpha-BHC	2.1 U	2.0 U	2.0 U	2.0 U	11 U
beta-BHC	2.1 U	2.0 U	2.0 U	2.0 U	11 U
delta-BHC	2.1 U	2.0 U	2.0 U	2.0 U	11 U
gamma-BHC (lindane)	2.1 U	2.0 U	2.0 U	2.0 U	11 U
Chlordane (technical)	21 U	20 U	20 U	20 U	110 U
Chlorobenzilate	40 U	39 U	39 U	39 U	210 U
4,4-DDD	2.1 U	2.0 U	2.0 U	2.0 U	11 U
4,4-DDE	2.1 U	2.0 U	2.0 U	2.0 U	11 U
4,4-DDT	2.1 U	2.0 U	2.0 U	2.0 U	11 U
Diallate	40 U	39 U	39 U	39 U	210 U
Dieldrin	2.1 U	2.0 U	2.0 U	2.0 U	11 U
Endosulfan I	2.1 U	2.0 U	2.0 U	2.0 U	11 U
Endosulfan II	2.1 U	2.0 U	2.0 U	2.0 U	11 U
Endosulfan sulfate	2.1 U	2.0 U	2.0 U	2.0 U	11 U
Endrin	2.1 U	2.0 U	2.0 U	2.0 U	11 U

TABLE 2 (Continued)

VALIDATED ANALYTICAL RESULTS FOR SOLUTIA, INC. SEDIMENT SAMPLES

Sample Identification	MR-SD-7-45	MR-SD-7-150	MR-SD-7-280	MR-SD-8-57	MR-SD-9-51
Date Collected	November 3, 2000			October 27, 2000	
Organochlorine Pesticides (µg/kg) (Continued)					
Endrin aldehyde	2.1 U	2.0 U	2.0 U	2.0 U	11 U
Heptachlor	2.1 U	2.0 U	[illegible]	2.0 U	11 U
Heptachlor epoxide	2.1 U	2.0 U	2.0 U	2.0 U	11 U
Isodrin	4.0 U	3.9 U	3.9 U	3.9 U	21 U
Kepone	40 U	39 U	39 U	39 U	210 U
Methoxychlor	4.0 U	3.9 U	3.9 U	3.9 U	21 U
Toxaphene	81 U	79 U	80 U	79 U	420 U
Polychlorinated Biphenyls (PCB) (µg/kg)					
Aroclor 1016	40 U	39 U	39 U	39 U	42 U
Aroclor 1221	40 U	39 U	39 U	39 U	42 U
Aroclor 1232	40 U	39 U	39 U	39 U	42 U
Aroclor 1242	40 U	39 U	39 U	39 U	42 U
Aroclor 1248	40 U	20 J	39 U	39 U	42 U
Aroclor 1254	40 U	39 U	39 U	39 U	42 U
Aroclor 1260	40 U	39 U	39 U	39 U	42 U
Organochlorine Herbicides (µg/kg)					
2,4-D	97 U	94 U	95 U	94 U	100 U
2,4,5-TP (Silvex)	24 U	24 U	24 U	24 U	25 U
2,4,5-T	24 U	24 U	24 U	24 U	25 U
Organophosphorus Pesticides (µg/kg)					
Dimethoate	40 U	39 U	39 U	39 U	42 U
Disulfoton	40 U	39 U	39 U	39 U	42 U
Famphur	40 U	39 U	39 U	39 U	42 U
Methyl parathion	40 U	39 U	39 U	39 U	42 U
Phorate	40 U	39 U	39 U	39 U	42 U
Tetraethyldithiopyrophosphate	40 U	39 U	39 U	39 U	42 U
Thionazin	40 U	39 U	39 U	39 U	42 U
o,o,o-Triethylphosphorothioate	40 U	39 U	39 U	39 U	42 U
General Chemistry (milligram per kilogram)					
Total organic carbon	780	120 U	120 U	120 U	3,700

TABLE 2 (Continued)

VALIDATED ANALYTICAL RESULTS FOR SOLUTIA, INC. SEDIMENT SAMPLES

Notes:

J	=	The result was estimated for quality control reasons.
U	=	The analyte was not detected; the numerical value is the sample reporting limit.
UJ	=	The analyte was not detected; the sample reporting limit is estimated for quality control reasons.

[a] Field duplicate of sample MR-SD-3-99

[b] Field duplicate of sample MR-SD-6-90.

Table 7-1

Maximum Detected Concentrations of Constituents Present in Whole Body Fish Tissue Samples

TABLE 7-1
Maximum Detected Concentrations of Constituents Present in Whole Body Fish Tissue Samples Collected in the Plume Discharge Area

	Upstream Downstream		Plume Discharge Area
SVOCS, µg/kg			
1,2-Dichlorobenzene	ND	**240** [1]	ND
1,4-Dichlorobenzene	ND	**130** [1]	ND
2,4-Dichlorophenol	ND	**190** [2]	ND
2-Methylphenol	110	220	340
Herbicides, µg/kg			
2,4,5-T	7.1	13	ND
2,4,5-TP (Silvex)	7.5	8.7	6.9
MCPP	ND	**8600** [2]	ND
Pesticides, µg/kg			
4,4-DDD	ND	**6.7** [3]	ND
4,4-DDE	25	60	19
4,4-DDT	7.6	13	ND
alpha-BHC	ND	**2.6** [1]	ND
alpha-Chlordane	5.6	14	7.7
gamma-Chlordane	5.8	8.1	3.5
Dieldrin	32	64	14
Endosulfan I	3	4.3	ND
Endrin	ND	**15** [2]	ND
Endrin Aldehyde	7.4	10	4.9
Heptachlor epoxide	ND	**5.3** [2]	ND
Dioxin, pg/g			
2,3,7,8- TCDD	3.3	2.4	0.96

Notes:

1) Detected in Forage Fish (Gizzard Shad)
2) Detected in Bottom Feeder Fish (Channel Catfish)
3) Detected in Predator Fish (Drum)

Concentrations shown in **bold** print represent constituents detected only in the plume discharge area.

Table 11-1

Groundwater Alternative 2 -

Physical Barrier

Cost Estimate

Table 5-1
Groundwater Alternative B - Physical Barrier

Summary		
Capital	Institutional Controls	$0
	Monitor Well/Piezometer Installation	$80,924
	Jet-Grouted Barrier Wall Installation	$6,336,500
	Extraction Well Installation	$385,473
	Groundwater Treatment at POTW	$0
	Subtotal, Capital Costs	$6,802,897
O&M (PV)	Institutional Controls	$248,181
	Monitoring	$1,764,603
	Extraction System O&M	$323,821
	Groundwater Treatment at POTW	$17,446,864
	Subtotal, O&M Costs, Present Value	$19,783,469
	Total Costs:	$26,586,366

NOTES
Costs are installed costs and include equipment, labor and materials
Primary source of cost data. ECHOS Environmental Remediation Cost Data 1998 - Assemblies.
All work done in level D.

Table 5-1
Groundwater Alternative B - Physical Barrier

Capital Costs	Extraction Well Installation Item.	Unit	Unit Cost	Quantity	Extended Cost	Per Well	No Wells
	Mob/Demob Rig & Crew for Recovery Well Installation	LS	$3.308	1	$3,308		
	12-in SS Casing, 10-ft Flush Thread Section	LF	$402 58	60	$24,155	20	
	12-in SS Casing, 5-ft Flush Thread Section	LF	$430.33	15	$6,455	5	
	12-in SS Well Screen	LF	$359.72	255	$91,729	85	
	12-in SS Well Plug	Ea	$767.56	3	$2,303	1	
	HS Auger, 16-in OD	LF	$110.28	330	$36,392	110	
	Drums	Ea	$65.19	75	$4,889		
	Haul Drummed Waste (1 Trip)	Mi	$1.44	502	$723		
	Cuttings Disposal (per Drum, Stabilization Required)	Ea	$236.33	75	$17,725		
	Gravel Pack	LF	$36.79	270	$9,933	90	
	Cement Grout	LF	$14 69	60	$881	20	
	Surface Completion/Vault	Ea	$3,659	3	$10,977	1	
	GW Pump. 5 HP, 230V, VFD, Controls, Probe	Ea	$4.656	3	$13,969		
	Restricted Area Well Protection	Ea	$1,077	3	$3,231	1	
	Control Building	Ea	$10.000	1	$10,000		
	12-in HDPE Piping (header and discharge piping)	LF	$14 47	6000	$86,820		
	Cat 225 Trenching, 1.5 CY	CY	$1 23	1778	$2,187		
	950 3 CY Backfill w/ Excavated Mat'l	CY	$1 70	1453	$2,470		
	Vibrating Plate Compaction	CY	$4 85	1453	$7,047		
	Design & Permitting (15% of Capital Costs)	LS			$50,279		
	Subtotal				$385,473		

Capital Costs	Barrier Wall Installation Item	Unit	Unit Cost	Quantity	Extended Cost
	Mob/Demob for Jet-Grouted Barrier Wall Installation	LS	$50.000	1	$50,000
	Total Construction Costs	SF	$13 00	420000	$5,460,000
	Design & Permitting (15% of Capital Costs)	LS			$826,500
				Subtotal	$6,336,500

Table 5-1
Groundwater Alternative B - Phvs cal Barrier

Deep Zone (100 ft)	Monitoring Well Installation Item	Unit	Unit Cost	Quantity	Extended Cost	
	Mob/Demob	LS	$2,401 00	0 25	$600	Based on 4
	OVA	DAY	$184 30	3	$553	well clusters
	Decon	DAY	$205 34	3	$616	
	2-in SS Well Casing	LF	$21 73	90	$1,956	
	2-in SS Well Screen	LF	$18 41	10	$184	
	2-in Submersible Pump	DAY	$63 86	3	$192	
	Hollow-stem Auger, 8-in OD	LF	$43 66	100	$4,366	
	2-in Screen Filter Pack	LF	$9 27	12	$111	
	Surface Pad, 4x4x4in	EA	$18 43	1	$18	
	2-in Well, Portland Cement Grout	LF	$0 92	86	$79	
	2-in Well, Bentonite Seal	EA	$34 34	1	$34	
	8x8x5-ft Steel Cover	EA	$365 64	1	$366	
	5-ft Guard Posts	EA	$61 84	4	$247	
		Deep Zone Subtotal, per Well			$9,323	

Intermediate Zone (60 ft td)	Monitoring Well Installation Item	Unit	Unit Cost	Quantity	Extended Cost
	Mob/Demob	LS	$2,401 00	0	$0
	OVA	DAY	$184 30	2	$369
	Decon	DAY	$205 34	2	$411
	2-in SS Well Casing	LF	$21 73	50	$1,087
	2-in SS Well Screen	LF	$18 41	10	$184
	2-in Submersible Pump	DAY	$63 86	2	$128
	Hollow-stem Auger 8-in OD	LF	$43 66	60	$2,620
	2-in Screen Filter Pack	LF	$9 27	12	$111
	Surface Pad 4x4x4in	EA	$18 43	1	$18
	2-in Well, Portland Cement Grout	LF	$0 92	46	$42
	2-in Well, Bentonite Seal	EA	$34 34	1	$34
	8x8x5-ft Steel Cover	EA	$365 64	1	$366
	5-ft Guard Posts	EA	$61 84	4	$247
		Intermediate Zone Subtotal per Well			$5,617

Table 5-1
Groundwater Alternative B - Physical Barrier

Shallow Zone (30 ft td)	**Monitoring Well Installation** Item	Unit	Unit Cost	Quantity	Extended Cost
	Mob/Demob	LS	$2 401 00	0	$0
	OVA	DAY	$184 30	1	$184
	Decon	DAY	$205 34	1	$205
	2-in SS Well Casing	LF	$21 73	20	$435
	2-in SS Well Screen	LF	$18 41	10	$184
	2-in Submersible Pump	DAY	$63 86	1	$64
	Hollow-stem Auger, 8-in OD	LF	$43 66	30	$1,310
	2-in Screen Filter Pack	LF	$9 27	12	$111
	Surface Pad, 4x4x4in	EA	$18 43	1	$18
	2-in Well Portland Cement Grout	LF	$0 92	16	$15
	2-in Well, Bentonite Seal	EA	$34 34	1	$34
	8x8x5-ft Steel Cover	EA	$365 64	1	$366
	5-ft Guard Posts	EA	$61 84	4	$247
			Shallow Zone Subtotal per Well		$3,174

	Piezometer Installation Item	Unit	Unit Cost	Quantity	Extended Cost	4 Piezometers
120 ft td	Mob/Demob	LS	$2 401 00	1	$2,401	
	1-in SS Well Casing	LF	$14 49	80	$1,159	
	1-in SS Well Screen	LF	$12 28	400	$4,912	
		Total Piezometers			$8,472	

Monitoring Well Installation Total per Three Zone Well Cluster	$18 113
Number of Clusters	4
Piezometer well Installation (4 fully penetrating wells)	$8,472
Total Monitoring Well/Piezometer Installation	$80,924

Table 5-1
Groundwater Alternative B - Physical Barrier

O&M Costs	Quarterly GW Sampling Item	Unit	Unit Cost	Quantity	Extended Cost	
	Volatiles	Ea	$175	48	$8.400	4
	Semi-volatiles	Ea	$457	48	$21.936	wells/cluster
	Metals	Ea	$290	48	$13.920	3
	PCBs/Pesticides	Ea	$207	48	$9.936	samples/event
	Dioxins	Ea	$182	48	$8,736	12
	Herbicides	Ea	$225	48	$10.800	no. events/yr
	OVA	Day	$184	12	$2,208	4
	Pump	Wk	$192	12	$2,304	
	Water Quality Meter	Day	$228	12	$2.736	
	Truck	Day	$33	12	$396	
	PPE	Day	$50	12	$600	
	Drums	Ea	$65	96	$6.240	
	Sampling Crew	Hr	$85	240	$20,400	
	Drum Loading	Ea	$6.21	96	$596	
	Drum Transport	Mi	$1 50	2008	$3,012	
	Drum Disposal	Ea	$140	96	$13.440	
	Report	Ea	$15.000	4	$60.000	
Subtotal. Quarterly GW Sampling					$185.660	
		Discount Rate	Period		Present Value	
Present Value, 5 yr period		0 07	5		$761,243	

O&M Costs	Semi-Annual GW Sampling Item	Unit	Unit Cost	Quantity	Extended Cost	
	Volatiles	Ea	$175	24	$4.200	4
	Semi-volatiles	Ea	$457	24	$10.968	wells/cluster
	Metals	Ea	$290	24	$6.960	3
	PCBs/Pesticides	Ea	$207	24	$4,968	samples/event
	Dioxins	Ea	$182	24	$4 368	12
	Herbicides	Ea	$225	24	$5.400	no events/yr
	OVA	Day	$184	6	$1.104	2
	Pump	Wk	$192	6	$1.152	
	Water Quality Meter	Day	$228	6	$1.368	
	Truck	Day	$33	6	$198	
	PPE	Day	$50	6	$300	
	Drums	Ea	$65	48	$3,120	
	Sampling Crew	Hr	$85	120	$10.200	
	Drum Loading	Ea	$6 21	48	$298	
	Drum Transport	Mi	$1 50	1004	$1.506	
	Drum Disposal	Ea	$140	48	$6,720	
	Report	Ea	$15,000	2	$30.000	
Subtotal, Semi-Annual GW Sampling					$92.830	
		Discount Rate	Period		Present Value	
Present Value, 30 yr period		0 07	30		$1,151 932	
Present Value, 5 yr period		0 07	5		$380 622	
Present Value. Years 5 thru 30					$771 311	

Note Quarterly sampling years 1 through 5, semi-annual sampling years 5 through 30

Table 5-1
Groundwater Alternative B - Physical Barrier

O&M Costs	Bioaccumulation Sampling Item	Unit	Unit Cost	Quantity	Extended Cost
	Mob/Demob	Ls	$5 000	1	$5 000
	Fish Composites	Ea	900	3	$2,700
	Analyses	Ea	2000	3	$6 000
	Report	Ls	5000	1	$5,000
	Subtotal, Bioaccumulation Sampling				$18,700
		Discount Rate	Period		Present Value
Present Value, 30 yr period		0 07	30		$232,049

O&M Costs	Treatment Item	Unit	Unit Cost	Quantity	Extended Cost	Flow, gpm
	Treatment/Disposal to POTW	10^3 gal	$5	281,196	$1,405,980	535
	Subtotal, Operation & Treatment				$1,405,980	
		Discount Rate	Period		Present Value	
Present Value, 30 yr period		0 07	30		$17,446,864	

O&M Costs	Operation Item	Unit	Unit Cost	Quantity	Extended Cost
	Monthly Maintenance	Ea	$600 00	12	$7,200
	Well Pump Replacement	Ea	$3,040	1	$3,040
	Electrical	Hr	$1 81	8760	$15,856
	Subtotal, Operation & Treatment				$26,096
		Discount Rate	Period		Present Value
Present Value, 30 yr period		0 07	30		$323,821

Costs	Institutional Controls Item	Unit	Unit Cost	Quantity	Extended Cost
	Qtrly Inspection, Report	Ea	$2 500	4	$10,000
	Annual Fencing, Signage Repairs	Ea	$5,000	1	$5,000
	Annual Public Meetings Information Distribution	Ea	$5 000	1	$5 000
	Subtotal, Annual Institutional Controls				$20 000
		Discount Rate	Period		Present Value
Present Value, 30 yr period		0 07	30		$248,181

APPENDIX A

PART III: RESPONSIVENESS SUMMARY

The responsiveness summary addresses public comments on the proposed plan for the interim groundwater remedial action at the Sauget Area 2 Superfund Site. The proposed plan was issued on June 17, 2002. A public comment period was held from June 17, 2002, to August 16, 2002, including a 30-day extension. An extension to the public comment period was requested. As a result, it was extended to August 16, 2002. A public meeting was held on June 24, 2002, to present the proposed plan and to accept oral and written comments.

SUMMARIZED COMMUNITY CONCERNS

Comment: *We have some very low lying areas around Kinder, Edward, and Angelo streets. By taking this type of action at the Site, will that hopefully affect the Village of Cahokia and lower the water.*

Response: The area of influence of the groundwater pumping is expected to extend only several hundred feet east of the grout wall. Therefore, the remedy will have no impact on groundwater levels in the Village of Cahokia.

Comment: *My experience as a resident in the floodplain with groundwater pumps is that they break down--a lot. There are incredible maintenance problems with them. In just ordinary American Bottom groundwater, there is a high iron content in and it has to be treated before it is released into any body of water. I can't imagine with all the chemicals involved in the Sauget Area 2 site--and they are not listed in your fact sheet--what that would do to pumping, treating, etc. There would undoubtedly be massive maintenance problems with the pumps. IDOT has given up pumping Highway 64 at East St. Louis because it is too expensive to continue pumping and to maintain the pumps.*

Response: The final design for groundwater pumps will reflect many years experience gained implementing pump-and-treat remedies at many other similar sites and will be specifically tailored to account for the unique chemical signature of groundwater underlying the Sauget sites. Also, a formal operations and maintenance (O&M) program will be in place to continuously monitor system performance. As such, we are confident that the proposed groundwater extraction and treatment system will continue to operate successfully for the duration of the project.

Comment: *Solutia's financial status has been shaky of late. If you opt for what you are proposing, will the taxpayers have to pick up the bill for the pumping? That needs to be addressed and the taxpayers need to have the opportunity to comment.*

Response - At this time, EPA believes the selected remedy will be implemented and operated by potentially responsible parties (PRPs). A number of viable PRPs have been identified for the Sauget Area 2 Site. The basic principal of the Superfund enforcement program is to make the responsible parties pay for the response activities needed to clean up sites. The enforcement program relies heavily upon the statutory authority provided by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), particularly sections 104, 106, 107, and 122. If PRP response is not voluntarily obtained or is not adequate, EPA can either issue an order to compel the PRP to conduct the cleanup, or conduct the necessary cleanup itself and fund the cleanup with Federal Trust Fund monies. In the latter situations where EPA has performed removal or remedial activities at the site or incurred any enforcement costs, the enforcement program's goal is to recover those costs from the PRPs.

Cost is a critical factor in the process of identifying a preferred remedy regardless of whether the action will be PRP or Fund lead. In fact, CERCLA and the NCP require that every remedy selected must be cost-effective. Of the remedies evaluated, the selected remedy is the most cost-effective. By choosing a cost-effective remedy, it is far more likely that the PRPs will be able to fund the selected remedy over the long term.

By having a strong enforcement program and selecting cost-effective remedies, EPA reduces the likelihood that the taxpayers will have to fund the response action.

Comment: *If the barrier method is used, for how long will it be in place?*

Response: Although the barrier wall is considered an interim groundwater remedial action, it is expected that this interim action will be compatible with and complement the final groundwater remedial action. Therefore, it is expected that the barrier wall will continue to be operated and maintained until the cleanup objectives determined in the final groundwater ROD are reached. The barrier is designed to be a permanent solution.

Comment: *What about the shrink-swell qualities of the soil?*

Response: Because the soils are principally granular - silts, sands, and gravels - they do not shrink or swell; shrink-swell characteristics are features of clay soils. In case the question is referring to the grout-wall, please be assured that comprehensive field-scale tests of various grout mixes are already underway to optimize grout-sand mixing strength and integrity.

Comment: *What about the groundwater levels changing? When the river is up groundwater flows away from the river. How is that addressed? Will that contaminate other waters?*

Response: A 1994 Geraghty & Miller report evaluated groundwater flow conditions at Site R. During low river stage conditions, groundwater at Sauget Area 2 flows from east to west and releases to the Mississippi River, the natural release point for groundwater in the American Bottoms aquifer. During periods of high river stage, when the river rises higher than the water table, gradients are reversed. For example, in November 1985 river stage was 32 to 33 feet above the USACE datum (low flow river stage is 5 to 7 feet above this datum). Groundwater elevation in the Middle Hydrogeologic Unit at the downgradient edge of Site R was 406 ft. Above mean sea level (MSL) and 394 ft. above MSL at Route 3. Under these conditions, groundwater flow was from west to east for a distance of approximately 4,500 feet. Flow in the upper, middle and deep hydrogeologic units is toward the east, but eventually reaches a stagnation point where the eastward gradient equals the westward regional gradient. This "riverbank storage effect" can last from several days to a few weeks. The Geraghty & Miller report found that analytical data from well clusters located adjacent to the flood control levee indicate that there has been little, if any, transport of constituents from Site R to the east. The Geraghty & Miller report on groundwater flow conditions at Site R is in Volume 2 of the Focused Feasibility Study which can be found in the Administrative Record.

The selected remedy address groundwater level changes by continuously recording and monitoring groundwater levels on either side of the grout wall using full-time telemetry that will be linked in real-time to adjecent river water levels. This will allow pumping rates to be constantly adjusted to account for changes in river level and to ensure that groundwater does not flow either east into the sites, or west and into the river. This water level monitoring and pumping rate adjusting will produce essentially zero-head conditions across the grout wall thereby minimizing the potential for contaminated groundwater to exit the site capture zone or for river water to enter the site and mix with contaminated groundwater.

Comment: *That area is in the New Madrid fault zone. The bridges just north of the site are being reinforced in anticipation of an earthquake. How would an earthquake affect each method?*

Response: The potential effects of a future earthquake are not a feature of the grout wall design because the grout wall, when finished, will be an integral part of the subsurface and will be laterally supported on all sides by the natural soil pressures. Typically, earthquake-specific design requirements are for aboveground structures. Should an earthquake occur, the integrity of the barrier wall would be evaluated and any necessary repairs made.

Comment: *Where have these methods been successfully tried? For how long a period?*

Response: There have been several successful applications of jet-grouting technology in Europe and North America. The technology has been around for several decades. One contractor Solutia has had discussions with on this project has built between 12 and 15 groundwater barriers using jet grouting techniques. One of these was constructed to a depth of 140 feet. Other contractors in the United States, Europe, and Japan have a similar experience record.

Comment: *We have heard there are plans to install other groundwater pumps in the flood plain. Has their impact on this site been evaluated?*

Response: EPA is unaware of the other pumps referenced above and whether the proposed pumping would impact the site.

Comment: *What is the area that will be affected by groundwater pumping? How will it affect the area wetlands? How will it affect any structures?*

Response: The area of influence of the groundwater pumping is expected to extend several hundred feet east of the grout wall, with the greatest drops in groundwater level occurring nearest the wall and associated groundwater pumps. Groundwater levels east of the existing levee should remain relatively unaffected. The actual radius of influence of the pumping wells will be determined during pre-construction aquifer pumping tests. Due to the limited influence of the groundwater pumping, there should be no impact on area wetlands and structures.

Comment: *You say the water will be treated before it is released into the river? How? Where will the toxins go? How clean will it be? Who will test it? How often will it be tested? Who will monitor the site? How often? Will there be split samples and independent labs?*

Response: Several groundwater treatment options are currently being evaluated. Selection of the actual treatment technologies and the location of the treatment system will be determined during the remedial design.

The treatment component of the groundwater alternative will utilize presumptive technologies identified in EPA's groundwater presumptive strategy, "Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Site", October 1996, Office of Solid Waste and Emergency Response (OSWER) Directive 9283.1-12. Since contaminants of concern include volatile and semivolatile organic compounds, one or more of the presumptive technologies - air stripping, granular activated carbon (GAC), chemical/UV oxidation and aerobic biological reactors - will be used for treating aqueous contaminants in the extracted groundwater. Final selection of these technologies will be based on additional site information to be collected during the remedial design. Based on this information and sound engineering practice, discharged water will have to meet applicable state and local permitting requirements for discharge to surface water. As a routine task, influent and effluent water qualities will be consistently sampled and monitored to ensure that all applicable treatment requirements are satisfied.

Comment: *Will the toxins volitalize?*

Response: Toxins comprising volatile organic compounds (VOCs) are found in the groundwater at the Site and do volatilize from groundwater into the air. It is this ability to volatilize that allows these chemicals to be readily removed from waste water during treatment. The treatment process will be designed to minimize the release of VOCs to the environment.

APPENDIX B

ADMINISTRATIVE RECORD INDEX

U S ENVIRONMENTAL PROTECTION AGENCY
REMEDIAL ACTION

ADMINISTRATIVE RECORD
FOR
SAUGET AREA 2 GROUNDWATER INTERIM ACTION
SAUGET AND CAHOKIA, ILLINOIS

ORIGINAL
JUNE 20, 2002

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
1	06/16/83	Ecology and Environment, Inc.	U.S. EPA	Preliminary Assessment for the Sauget/Sauget and Company Landfill Site	20
2	05/00/88	Ecology and Environment, Inc.	Illinois EPA	Final Report: Expanded Site Inspection for the Dead Creek Sediment Sites at Cahokia/Sauget, IL: Volume 1 of 2 (Text, Figures and Tables)	476
3	05/00/88	Ecology and Environment, Inc.	Illinois EPA	Final Report: Expanded Site Inspection for the Dead Creek Sediment Sites at Cahokia/Sauget, IL: Volume 2 of 2 (Appendices A-F)	554
4	12/10/98	Federal Register	Public	National Recommended Water Quality Critera: Notice; Republication (FR Part IV EPA: Vol. 63, No 237)	12
5	06/23/00	Carney, W., U.S. EPA	Addressees	Letter re: Special Notice of Liability for the Sauget Area 2 Site	82
6	08/01/00	Solutia, Inc	U.S. EPA	Description of Current Conditions for the W.G. Krummrich Plant, Sauget, Illinois: Volume 1 (Text, Tables, Figures, Attachments 1-4 and Appendices 1-15 **[DRAFT]**	156
7	08/25/00	Tetra Tech EM, Inc.	U.S. EPA	Community Involvement Plan for Sauget Areas 1 and 2 Superfund Sites w/ Cover Letter	34
8	09/01/00	Solutia, Inc.	U.S EPA	Description of Current Conditions for the W G. Krummrich Plant, Sauget, Illinois Volume 2 (Appendices 16-23) **[DRAFT]**	687

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
9	09/01/00	Solutia, Inc.	U.S. EPA	Description of Current Conditions for the W.G. Krummrich Plant, Sauget, Illinois Volume 3(Appendices 24-25) **[DRAFT]**	679
10	10/03/00	Illinois EPA	File	Illinois EPA HazMat Incident Report re: a Crude Chlorobenzene Spill at the Solutia, Inc. Facility w/Attachments	6
11	10/10/00	Mosher, B., Illinois EPA	Bardo, K., U.S. EPA	FAX Transmission re: Listing of Derived Water Quality Criteria as Published in the Illinois Register	11
12	10/13/00	Bardo, K., U.S. EPA	Mosher, B., Illinois EPA	FAX Transmission re: Water Quality Criteria Standards	2
13	11/24/00	U.S. EPA	Respondents	Administrative Order by Consent re: the Sauget Area 2 Site	59
14	01/22/01	Graczyk, L., Tetra Tech EM, Inc.	Freeman, B., U.S. EPA	Letter: Data Validation Report for Samples Collected October 24-November 3, 2000 at the Solutia, Inc. Facility	58
15	01/26/01	Search, G., Illinois EPA	Illinois EPA	Memorandum re: January 25, 2001 Meeting to Discuss Monochlorobenzene Release at the Solutia, Inc. Facility w/Attachments	33
16	02/09/01	Hamper, G., U.S. EPA	Hiller, R., Solutia, Inc.	Letter re: Water Quality Criteria at Solutia, Inc. w/Attachments	28
17	05/15/01	Graczyk, L., Tetra Tech EM, Inc.	Barr, J., Dyna Corp.	Chain of Custody Forms and Data Summary Forms for Solutia, Inc. w/Cover Letter	
18	06/01/01	Menzie-Cura & Associates, Inc.	Solutia, Inc.	Report: Ecological Risk Assessment for the W.G. Krummrich Plant in Sauget, IL **(REV. 1: INTERNAL REVIEW DRAFT)**	992
19	08/09/01	Bardo, K., U.S. EPA	Hiller, R., Solutia, Inc.	Letter re: U.S. EPA's Comments on Solutia, Inc.'s June [illegible], 2001 Ecological Risk Assessment w/ Attachment	[illegible]

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
20	11/14/01	Ribordy, M., U.S. EPA	Smith, S., Solutia, Inc.	Letter re: Notification of Additional Work for the Focused Feasibility Study for Groundwater Contamination at Site R, Sauget Area 2 w/Attachment	11
21	03/31/02	Solutia, Inc.	U.S. EPA	Focused Feasibility Study for Sauget Area 2 Sites O, Q, R and S (Volume 1: Text, Tables and Figures)	433
22	03/31/02	Solutia, Inc.	U.S. EPA	Focused Feasibility Study for Sauget Area 2 Sites O, Q, R and S (Volume 2: Design Basis and Design)	905

UPDATE #1
JUNE 27, 2002

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
1	06/00/02	U.S. EPA	Public	Fact Sheet: U.S. EPA Issues Proposed Plan for Interim Ground-water Cleanup At Sauget Area 2 Site	8

UPDATE #2
JULY 24, 2002

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
1	06/24/02	Pohlman Reporting Company	U.S. EPA	Transcript of the June 24, 2002 Public Meeting re: the Sauget Area 2 Superfund Site	32

UPDATE #3
SEPTEMBER 23, 2002

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
1	09/00/01	Roy F. Weston, Inc.	U.S. EPA	Site Assessment Report for the Clayton Chemical Site in Sauget, IL	
2	06/00/02	U.S. EPA	Public	Fact Sheet: U.S. EPA Issues Proposed Plan for Interim Ground-Water Cleanup at Sauget Area 2 Site	8
3	06/17/02	Belleville News-Democrat	Public	U.S. EPA Public Notice: Announcement of a Public Meeting and Public Comment Period for the Proposed Plan for the Sauget Area 2 Site	1

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
4	07/17/02	Andria, K., American Bottom Conservancy	Hill, S., U.S. EPA	E-Mail Transmission re: Request for 30 Day Extension to the Public Comment Period on the Proposed Plan for the Sauget Area 2 Site	1
5	07/17/02	Andria, K., American Bottom Conservancy	Hill, S., U.S. EPA	E-Mail Transmission re: Public Comment on the Proposed Plan for the Sauget Area 2 Site	1
6	07/23/02	U.S. EPA	Public	Postcard: U.S. EPA Announcement of a Public Comment Extension for the Proposed Plan for the Sauget Area 2 Site	2
7	00/00/00	U.S. EPA	Public	Record of Decision for the Sauget Area 2 Ground-water Interim Action **(PENDING)**	

APPENDIX C

PRESUMPTIVE RESPONSE STRATEGY AND EX-SITU TREATMENT TECHNOLOGIES FOR CONTAMINATED GROUND WATER AT CERCLA SITES

FINAL GUIDANCE

Directive 9283.1-12
EPA 540/R-96/023
PB96-963508
October 1996

PRESUMPTIVE RESPONSE STRATEGY AND EX-SITU TREATMENT TECHNOLOGIES FOR CONTAMINATED GROUND WATER AT CERCLA SITES

FINAL GUIDANCE

Office of Solid Waste and Emergency Response
U.S. Environmental Protection Agency
Washington, DC 20460

NOTICE

This document provides guidance to EPA staff. It also provides guidance to the public and to the regulated community on how EPA intends to exercise its discretion in implementing the National Contingency Plan. The guidance is designed to implement national policy on these issues. The document does not, however, substitute for EPA's statutes or regulations, nor is it a regulation itself. Thus, it cannot impose legally-binding requirements on EPA, States, or the regulated community, and may not apply to a particular situation based upon the circumstances. EPA may change this guidance in the future, as appropriate.

CONTENTS

APPENDICES

FIGURES

HIGHLIGHTS

ACRONYMS USED IN THIS GUIDANCE

ACL	Alternate Concentration Limit
ARAR	Applicable or Relevant and Appropriate Requirement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended by SARA
CERI	Center for Environmental Research Information
CFR	Code of Federal Regulations
CSGWPP	Comprehensive State Ground Water Protection Program
DNAPL	Dense Nonaqueous Phase Liquids
EPA	Environmental Protection Agency
ESD	Explanation of Significant Differences
FS	Feasibility Study
GAC	Granular Activated Carbon
LNAPL	Light Nonaqueous Phase Liquids
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
NAPL	Nonaqueous Phase Liquid
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
OERR	Office of Emergency and Remedial Response
ORD	Office of Research and Development
OSWER	Office of Solid Waste and Emergency Response
PCB	Polychlorinated Biphenyl Compounds
POTW	Publicly Owned Treatment Works
RARA	Resource Conservation and Recovery Act
RD	Remedial Design
RD/RA	Remedial Design/Remedial Action
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SACM	Superfund Accelerated Cleanup Model
SARA	Superfund Amendments and Reauthorization Act of 1986
UV	Ultra Violet (light)
VOC	Volatile Organic Compound

PREFACE

Presumptive Remedies Initiative. The objective of the presumptive remedies initiative is to use the Superfund program's past experience to streamline site investigations and speed up selection of cleanup actions. Presumptive remedies are expected to increase consistency in remedy selection and implementation, and reduce the cost and time required to clean up similar types of sites. T· presumptive remedies approach is one tool within the Superfund Accelerated Cleanup Model (SACM) (EPA, 1992d).

Presumptive remedies are preferred technologies for common categories of sites, based on historical patterns of remedy selection and EPA's scientific and engineering evaluation of performance data on technology implementation. Refer to EPA Directive, *Presumptive Remedies: Policy and Procedures* (EPA, 1993d) for general information on the presumptive remedy process and issues common to all presumptive remedies. This directive should be reviewed before utilizing a presumptive remedy and for further information on EPA expectations concerning the use of presumptive remedies. **"Presumptive remedies are expected to be used at all appropriate sites,"** except under unusual site-specific circumstances (EPA, 1993d).

Other Presumptive Remedy Guidance. Previous fact sheets from EPA's Office of Solid Waste and Emergency Response (OSWER) have established presumptive remedies for municipal landfill sites (EPA, 1993f), for sites with volatile organic compounds in soils (EPA, 1993e) and for wood treater sites (EPA, 1995g). A presumptive response selection strategy for manufactured gas plant sites is under development. Additional fact sheets are in progress for sites contaminated with polychlorinated biphenyl compounds (PCBs), metals in soils and for grain storage sites.

Relation of this Guidance to Other Presumptive Remedies. The fact sheets mentioned above provide presumptive remedies (or a strategy for selecting remedies) for "source control" at specific types of sites. With respect to ground-water response, source control refers to containment or treatment of materials that may leach contaminants to ground water, or a combination of these approaches. In general, treatment is expected for materials comprising the principal threats posed by a site, while containment is preferred for low level threats (EPA, 1991c) Where contaminants have reached ground water and pose an unacceptable risk to human health or the environment, a ground-water remedy will generally be required in addition to the source control remedy and this guidance should be consulted

Instead of establishing one or more presumptive remedies, this guidance defines a **presumptive response strategy**. EPA expects that some elements of this strategy will be appropriate for **all** sites with contaminated ground water and all elements of the strategy will be appropriate for many of these sites. In addition, this guidance identifies **presumptive technologies** for the ex-situ treatment component of a ground-water remedy, that are expected to be used for sites where extraction and treatment is part of the remedy. (The term presumptive technology is used in this guidance to denote only the ex-situ treatment component of a ground-water remedy) Other remedy components could include methods for extracting ground water, enhancing contaminant recovery or degradation of contaminants in the subsurface, discharging treated water, preventing contaminant migration, and institutional or engineering controls to prevent exposure to contaminants

Applicability to RCRA Corrective Action Program. EPA continues to seek consistency between cleanup programs, especially in the process of selecting response actions for sites regulated under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA or Superfund program) and corrective measures for facilities regulated under the Resource Conservation and Recovery Act (RCRA) In general, even though the Agency's presumptive remedy guidances were developed for CERCLA sites they should also be used at RCRA Corrective Action sites to focus RCRA Facility Investigations, simplify evaluation of remedial alternatives in the Corrective Measures Study, and influence remedy selection in the Statement of Basis For more information refer to the RCRA Corrective Action Plan (EPA, 1994c), the proposed Subpart S regulations (Federal Register, 1990b), and the May 1, 1996 RCRA Corrective Action Advance Notice of Proposed Rulemaking (Federal Register, 1996)

Use of this Guidance. The **presumptive response strategy**, described in Section 2 1, integrates site characterization, early actions, remedy selection, performance monitoring, remedial design and remedy implementation activities into a comprehensive, overall response strategy for sites with contaminated ground water By integrating these response activities, the presumptive strategy illustrates how the Superfund Accelerated Cleanup Model (SACM) can be applied to ground-water cleanup Although this response strategy will not necessarily streamline the remedial investigation/feasibility study (RI/FS) phase, EPA expects that use of the presumptive strategy will result in significant time and cost savings for the overall response to contaminated ground water By providing a mechanism for selecting achievable remediation objectives, the presumptive strategy will minimize the need for changing these objectives during remedy implementation By optimizing the remedy for actual site conditions during implementation, the effectiveness of the selected remedy can be greatly increased, which will reduce the time and cost required to achieve remediation objectives

The **presumptive technologies** for treating extracted ground water, identified in Section 3 1, are the technologies that should generally be retained for further consideration in the Detailed Analysis portion of the feasibility study (or in the remedial design as explained in Section 3 3 3) This guidance and its associated Administrative Record will generally constitute the Development and Screening of Alternatives portion of the feasibility study (FS) for the ex-situ treatment component of a ground-water remedy (see Section 3 3 2) In this respect, the presumptive technologies will streamline the FS for this component of a ground-water remedy in the same way that other "presumptive remedies" streamline the FS for the overall remedy for their respective site types (see EPA, 1993d)

1.0 INTRODUCTION

In implementing the Superfund and other remediation programs, cleanup of contaminated ground water has proven to be more difficult than anticipated. For many sites, the program expectation of returning ground waters to their beneficial uses (see Section 1 2 1) often requires very long time periods and may not be practicable for all or portions of the site Thus, the ultimate cleanup goal for ground water may need to be different over different areas of the site (see Section 1 3 1) For sites where achieving the ultimate goal will require a long time period, interim remediation objectives will generally be appropriate, such as preventing further plume migration. **Therefore, a critical first step in the remedy selection process is to determine the full range of remedial objectives that are appropriate for a particular site.**

This guidance is intended to emphasize the importance of using site-specific remedial objectives as the focus of the remedy selection process for contaminated ground water Those remedy components ~~that~~ influence attainment of remedial objectives should receive the greatest attention For example if restoring the aquifer to beneficial use is the ultimate objective, remedy components that influence attainment of cleanup levels in the aquifer include methods for extracting ground water, enhancing contaminant recovery, controlling subsurface contaminant sources (e g , nonaqueous phase liquids or NAPLs, discussed in Appendix A1) or in-situ treatment of contaminants **Some or all of these remedy components should be included in remedial alternatives that are developed and evaluated in detail in the feasibility study (FS) when aquifer restoration is a remedial objective.**

Although the technologies employed for treating extracted ground water and the types of discharge for the treated effluent are important aspects of a remedy, they have little influence on reducing contaminant levels or minimizing contaminant migration in the aquifer In developing this guidance, historical patterns of remedy selection and available technical information were reviewed in order to identify presumptive technologies for ex-situ treatment of ground water **By providing presumptive technologies, this guidance attempts to streamline selection of these technologies and shift the time and resources employed in remedy selection to other, more fundamental aspects of the ground-water remedy.**

Although extraction and treatment has been and will continue to be used as part of the remedy for many sites with contaminated ground water, it may **not** be the most appropriate remediation method for all sites or for all portions of a given contaminant plume Also, remedial alternatives that combine extraction and treatment with other methods, such as natural attenuation (defined in Section 2 6 5) or in-situ treatment, may have several advantages over alternatives that utilize extraction and treatment alone (see Section 2.4 2) (Remedial alternatives are evaluated against remedy selection criteria defined in the National Contingency Plan at §300 430(e)(9)(iii) (Federal Register, 1990a)) In general, the remedy selection process should consider whether extraction and treatment can achieve remedial objectives appropriate for the site and how this approach can be most effectively utilized to achieve these objectives **This guidance also describes a presumptive response strategy which facilitates selection of both short and long-term remediation objectives during remedy selection, and allows the effectiveness of the remedy to be improved during implementation.**

1.1 Purpose of Guidance

In summary, this guidance is intended to

- **Describe a presumptive response strategy**, at least some elements of which are expected to be appropriate for **all** sites with contaminated ground water,

- **Identify presumptive technologies** for treatment of extracted ground water (ex-situ treatment) that are expected to be used (see EPA,1993d) for sites where extraction and treatment is part of the remedy:

- **Simplify the selection** of technologies for the ex-situ treatment component of a ground-water remedy, and improve the technical basis for these selections; and

- **Shift the time and resources** employed in remedy selection from ex-situ treatment to other, more fundamental aspects of the ground-water remedy, as discussed above.

1.2 Expectations and Objectives for Ground-Water Cleanup

Careful consideration should be given to national program expectations as well as site-specific conditions when determining cleanup objectives that are appropriate for a given site.

1.2.1 Program Expectations. Expectations for contaminated ground water are stated in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), as follows

> "EPA expects to return usable ground waters to their **beneficial uses** wherever practicable, within a **timeframe** that is reasonable given the particular circumstances of the site When restoration of ground water to beneficial uses is **not practicable**, EPA expects to prevent further migration of the plume, prevent exposure to the contaminated ground water, and evaluate further risk reduction " (Federal Register, 1990a, §300 430 (a)(1)(iii)(F), emphasis added)

The Preamble to the NCP explains that the program expectations are not "binding requirements " "Rather, the expectations are intended to share collected experience to guide those developing cleanup options" (Federal Register, 1990a, at 8702)

1.2.2 Objectives for Site Response Actions. The program expectations can be used to define the following overall objectives for site response actions, which are generally applicable for **all** sites with contaminated ground water:

- Prevent exposure to contaminated ground water, above acceptable risk levels;

- Prevent or minimize further migration of the contaminant plume (plume containment);

- Prevent or minimize further migration of contaminants from source materials to ground water (source control); and

- Return ground waters to their expected beneficial uses wherever practicable (aquifer restoration).

In this guidance the term "response action" is used to indicate an action initiated under either CERCLA removal or remedial authority. "Response objective" is the general description of what a response action is intended to accomplish Source control is included as an objective because the NCP expectation of aquifer restoration will not be possible unless further leaching of contaminants to ground water is controlled, from both surface and subsurface sources **The objectives, given above, are listed in the sequence in which they should generally be addressed at sites.**

Monitoring of ground-water contamination is not a separate response objective, but is necessary to verify that one or more of the above objectives has been attained, or will likely be attained (see Section 2 1 3) Other response objectives may also be appropriate for some sites, depending on the type of action being considered and site conditions (e g , maximizing the reuse of extracted ground water may be an appropriate objective for some sites) **Response objectives may be**

different over different portions of the contaminant plume, as discussed in Section 1 3 1

1.3 Lessons Learned

The most important lesson learned during implementation of Superfund and other remediation programs is that complex site conditions are more common than previously anticipated, including those related to the source and type of contaminants as well as site hydrogeology As a result of these site complexities, restoring all or portions of the contaminant plume to drinking water or similar standards may not be possible at many sites using currently available technologies.

1.3.1 Sources and Types of Contaminants. Approximately 85 percent of sites on the CERCLA National Priorities List (NPL sites) have some degree of ground-water contamination Contaminants have been released to ground water at a wide variety of site types and can include a variety of contaminants and contaminant mixtures. **Sources of** contaminants to ground water not only include facilities from which the original release occurred (e.g., landfills, disposal wells or lagoons, storage tanks and others) but also include contaminated soils or other subsurface zones where contaminants have come to be located and can continue to leach into ground water (e.g., NAPLs, see Appendix A1) Thus, the plume of contaminated ground water may encompass NAPLs in the subsurface (sources of contamination) as well as dissolved contaminants In this case, different response objectives may be appropriate for different portions of the plume For example, source control (e.g., containment) may be the most appropriate response objective for portions of the plume where NAPLs are present and can not practicably be removed, while aquifer restoration may be appropriate only for the remaining portions of the plume (see Section 2.5 3)

Although originating from a variety of sources, contaminants which reach ground water tend to be those that are relatively mobile and chemically stable in the subsurface environment (e g , less likely to sorb to soil particles or degrade above the water table) Organic and inorganic contaminants most frequently found in ground water at CERCLA sites are listed in Appendix A2. Sixteen of the 20 most common organic contaminants are volatile organic compounds (VOCs). Of the 16 VOCs, 12 are chlorinated solvents and four are chemicals found in petroleum fuels. Petroleum fuels are **light** nonaqueous phase liquids (LNAPLs, with a density lighter than water); while most chlorinated solvents are **dense** nonaqueous phase liquids (DNAPLs) in pure form (see Appendix A1).

1.3.2 Factors Limiting Restoration Potential. At many sites, restoration of ground water to cleanup levels defined by applicable or relevant and appropriate requirements (ARARs) or risk-based levels may not be possible over all or portions of the plume using currently available technologies. Two types of **site conditions** inhibit the ability to restore ground water:

- Hydrogeologic factors, and
- Contaminant-related factors.

Recent studies by EPA and others have concluded that complex site conditions related to these factors are more common at hazardous waste sites than originally expected (EPA, 1989a, 1992b, 1992g, and 1993b, and the National Research Council, 1994) Examples of hydrogeologic or contaminant-related factors affecting the difficulty of restoring ground water are given in Figure 1 These types of site conditions should be considered in the **site conceptual model**, which is an interpretive summary of the site information obtained to date (**not** a computer model) Refer to EPA, 1993b and 1988a for additional information concerning the site conceptual model. **For every site, data should be reviewed or new data should be collected to identify factors that could increase (or decrease) the difficulty of restoring ground water.**

Figure 1 Examples of Factors Affecting Ground-Water Restoration Potential

Certain site characteristics may limit the effectiveness of subsurface remediation The examples listed below are highly generalized The particular factor or combination of factors that may critically limit restoration potential will be site specific (Figure 1 is taken from EPA, 1993b with minor modifications)

Site/Contaminant Characteristics

Generalized Remediation Difficulty Scale

Increasing difficulty →

Site Use	Nature of Release	Small Volume Short Duration Slug Release →	Large Volume Long Duration Continual Release
Chemical Properties	Biotic/Abiotic Decay Potential	High →	Low
	Volatility	High →	Low
	Contaminant Retardation (Sorption) Potential	Low →	High
Contaminant Distribution	Contaminant Phase	Aqueous, Gaseous → Sorbed → LNAPLs →	DNAPLs
	Volume of Contaminated Media	Small →	Large
	Contaminant Depth	Shallow →	Deep

Hydrogeologic Characteristics

Geology	Stratigraphy	Simple Geology, e g , Planar Bedding Strata →	Complex Geology, e g , Interbedded and Discontinuous
	Texture of Unconsolidated Deposits	Sand →	Clay
	Degree of Heterogeneity	Homogeneous e g well-sorted sand →	Heterogeneous e g , interbedded sand and silts, clays, fractured media karst
Hydraulics/Flow	Hydraulic Conductivity of Aquifer	High (>10^{2} cm/sec) →	Low (< 10^{4} cm/sec)
	Temporal Variation of Flow Regime	Little/None →	High
	Vertical Flow	Little Component →	Large Downward Flow

1.3.3 Assessing Restoration Potential. Characterizing **all** site conditions that could increase the difficulty of restoring ground water is often not possible As a result, the likelihood that ARAR or risk-based cleanup levels can be achieved (**restoration potential**) is somewhat to highly uncertain for many sites, even after a relatively complete remedial investigation This uncertainty can be reduced by using remedy performance in combination with site characterization data to assess the restoration potential By implementing a ground-water remedy in more than one step or phase (as two separate actions or phasing of a single action as described in Section 2 2), performance data from an initial phase can be used to assess the restoration potential and may indicate that additional site characterization is needed In addition to providing valuable data, the initial remedy phase can be used to attain short-term response objectives, such as preventing further plume migration Phased implementation of response actions also allows realistic long term remedial objectives to be determined prior to installation of the comprehensive or "final" remedy

A detailed discussion of factors to consider for assessing restoration potential is provided in *Guidance for Evaluating the Technical Impracticability of Ground-Water Restoration* (EPA, 1993b, Section 4 4 4) An especially important tool for this evaluation is the site conceptual model, which should integrate data from site history, characterization and response actions This assessment could provide justification for waiving ARARs due to technical impracticability from an engineering perspective over all or portions of a site (EPA, 1993b) It is recommended that technical assistance be enlisted from regional technical support staff or the Technical Support Project (EPA, 1994d) when evaluating technical impracticability

Data from remedy performance are not always necessary to justify an ARAR waiver due to technical impracticability (see Section 2 6 3) At the completion of the remedial investigation (RI), site conditions may have been characterized to the extent needed for EPA (or the lead agency) to determine that ground-water restoration is technically impracticable from an engineering perspective (EPA, 1993b, EPA 1995b) For this case, an ARAR waiver request can be submitted to EPA (or the lead agency), and if approved, included in the Record of Decision (ROD) It will often be appropriate to include an ARAR waiver in the ROD for portions of a site where DNAPLs have been confirmed in the aquifer (see Section 2 5 3)

2.0 PRESUMPTIVE RESPONSE STRATEGY

2.1 Definition and Basis for Strategy

Key elements of the presumptive strategy are summarized in Highlight 1 In the presumptive response strategy, site characterization and response actions are implemented in a several steps, or in a **phased approach** In a phased response approach, site response activities are implemented in a sequence of steps, or phases, such that information gained from earlier phases is used to refine subsequent investigations, objectives or actions (EPA, 1989a, 1992b, 1993b)

In general for sites with contaminated ground water, <u>site characterization</u> should be coordinated with <u>response actions</u> and <u>both</u> should be implemented in a step-by-step or phased approach.

Performance data from an initial response action are also used to assess the likelihood that ARAR or risk-based cleanup levels can be attained by later, more comprehensive actions Although it is recognized that phased implementation may not be appropriate for all ground-water remedies, EPA expects that some elements of this strategy will be appropriate for **all** sites with contaminated ground water and that all elements will be appropriate for many of these sites **For this reason, the response approach given in**

Highlight 1. Presumptive Response Strategy

- For sites with contaminated ground water, **site characterization should be coordinated with response actions** and both should be implemented in a phased approach (Sections 1.3.3 and 2.1).
- **Early or interim actions** should be used to reduce site risks (by preventing exposure to and further migration of contaminants) and to provide additional site data (Section 2.1.2).
- Site characterization and performance data from early or interim ground-water actions should be used to **assess the likelihood of restoring ground water** to ARAR or risk-based cleanup levels (restoration potential). (Sections 1.3.3 and 2.1.2.)
- The restoration potential should be assessed **prior to establishing objectives for the long-term remedy** (Sections 1 3 3 and 2 1 2)
- All ground-water actions should include provisions for **monitoring and evaluating their performance** (Section 2.1.3).
- Ground-water response actions, especially those using extraction and treatment, should generally be **implemented in more than one phase** -- either as two separate actions or phasing of a single action (Sections 2.2.1 and 2.2.2).
- In addition to phasing, **post-construction refinements** will generally be needed for **long-term** remedies, especially those using extraction and treatment (Section 2 3 1)

Highlight 1 is a presumptive strategy for contaminated ground water.

Also, this response strategy is considered presumptive because the **basic elements were included in <u>all</u> previous policy directives** concerning ground-water remediation from EPA's Office of Solid Waste and Emergency recommended use of a phased approach for site characterization and response actions, and more frequent use of early actions to reduce site risks Better integration of site activities and more frequent use of early actions are also essential components of the Superfund Accelerated Cleanup Model (SACM), defined in EPA, 1992d

2.1.1 Benefits of Phased Approach. Implementing investigations and actions in phases provides the following major **benefits**:

- Data from earlier response actions are used to further characterize the site and assess restoration potential;
- Attainable objectives can be set for each response phase;
- Flexibility is provided to adjust the remedy in response to unexpected site conditions,
- Remedy performance is increased, decreasing remediation timeframe and cost; and
- Likely remedy refinements are built into the selected remedy, better defining the potential scope and minimizing the need for additional decision documents

2.1.2 Early Actions. "Early" refers to the timing of the start of an action with respect to other response actions at a given site For Superfund sites, early actions could include removal actions, interim remedial actions, or early final remedial actions (EPA, 1992b and EPA, 1991b) Although initiated prior to other actions, some early ground-water actions may need to operate over a long time period (e.g., hydraulic containment actions). In this guidance the later, more comprehensive ground-water action is called the "long-term remedy," consistent with SACM terminology (EPA, 1992e). Early actions that should be considered in response to contaminated ground water are listed in Highlight 2, categorized by response objective. **Early or interim actions should be used to reduce site risks (by preventing exposure to contaminated ground water and further migration of contaminants) and to provide additional site data.**

Factors for determining which response components are suitable for early or interim actions include: the timeframe needed to attain specific objectives, the relative urgency posed by potential or actual exposure to contaminated ground water (e.g., likelihood that contaminants will reach drinking water wells), the degree to which an action will reduce site risks, usefulness of information to be gained from the action, site data needed to design the action, and compatibility with likely long-term actions (EPA, 1992e). Whether to implement early response actions and whether to use removal or remedial authority for such actions should be determined by the "Regional Decision Team" defined under SACM (EPA, 1992f) or similar decision-making body for the site.

Early or interim actions should be integrated as much as possible with site characterization and with subsequent actions in a phased approach. Once implemented, early actions will often provide additional site characterization information, which should be used to update the site conceptual model. Also, treatability studies (see Section 3 4.5) needed for selection or design of the long-term remedy should be combined with early actions whenever practical. Site characterization and performance data from early or interim ground-water actions should be used to assess the likelihood of restoring ground water to ARAR or risk-based cleanup levels (restoration potential). **The restoration**

Highlight 2. Early Actions That Should Be Considered

Prevent exposure to contaminated ground water:

- Plume containment
- Alternate water supply
- Well head treatment
- Use restrictions

Prevent further migration of **contaminant plume**:

- Plume containment
- Contain (and/or treat) plume "hot spots"

Prevent further migration of contaminants **from sources**:

- Source removal and/or treatment
  - Excavate wastes or soils and remove from site
  - Excavate soils and treat ex-situ
  - Treat soils in-situ
  - Extract **free-phase NAPLs** (see Appendix A1)
- Source containment
  - Contain wastes or soils
  - Contain subsurface **NAPLs**

Provide additional site data:

- Assess restoration potential
- Combine actions with treatability studies

potential should be assessed prior to establishing objectives for the long-term remedy (see Section 1.3.3). **2.1.3 Monitoring.** Monitoring is needed to evaluate whether the ground-water action is achieving, or will achieve, the intended response objectives for the site (see Section 1 3.1) and other performance objectives for the action (e.g., discharge requirements). **All ground-water actions should include provisions for monitoring and evaluating their performance.** A monitoring plan should be developed for both early and long-term actions. In general, the monitoring plan should include:

- Response objectives and performance requirements for the ground-water action;
- Specific monitoring data to be collected;
- Data quality objectives;
- Methods for collecting, evaluating and reporting the performance monitoring data; and
- Criteria for demonstrating that response objectives and performance requirements have been attained

Flexibility for adjusting certain aspects of monitoring during the life of the remedy should be included in the monitoring plan, such as changes in the monitoring frequency as the remedy progresses or other changes in response to remedy refinements (see Section 2 3 1) A detailed discussion of the data quality objectives process is provided in EPA, 1993j. Methods for monitoring the performance of extraction and treatment actions are discussed in EPA, 1994e

2.2 Phased Response Actions

In general, ground-water response actions, especially those using extraction and treatment, should be implemented in more than one phase. There are two options for phasing response actions - implementation of two separate actions, or implementation of a single action in more than one phase It is recognized that phased implementation may not be appropriate for all ground-water remedies. In some cases, it may be more appropriate to install the entire remedy and then remove from service those components that later prove to be unneeded

2.2.1 Two Separate Actions. In this approach an early or interim ground-water action is followed by a later, more comprehensive action (the long-term remedy) A flow chart of this approach is given in Figure 2. Earlier ground-water actions are used to mitigate more immediate threats, such as preventing further plume migration. Response objectives for the long-term remedy are not established until after performance of the earlier action is evaluated and used to assess the likelihood that ground-water restoration (or other appropriate objectives) can be attained. Two separate decision documents are used, in which response objectives are specified that are appropriate for each action. The earlier decision document could be an Action Memorandum or an Interim Record of Decision (Interim ROD), since the early action could be initiated under either CERCLA removal or remedial authority. **This approach should be used when site characterization data are not sufficient to determine the likelihood of attaining long-term objectives (e.g., restoring ground water) over all or portions of the plume, which will be the case for many sites.** In order to provide sufficient data for assessing the restoration potential, the early or interim action may need to operate for several years

2.2.2 Phasing of a Single Action. In this approach the long-term remedy for ground water is implemented in more than one design and construction phase A flow chart of this approach is given in Figure 3 Response objectives for the long-term remedy are specified in a single Record of Decision (ROD) prior to implementing the remedy Provisions for assessing the attainability of these objectives using performance data from an initial remedy phase are also included in the ROD Thus, phased remedy implementation and assessment of remedy performance are specified in one ROD A second decision document could still be required if evaluation of the first phase

Figure 2 Phased Ground-Water Actions Early Action Followed by Long-Term Remedy

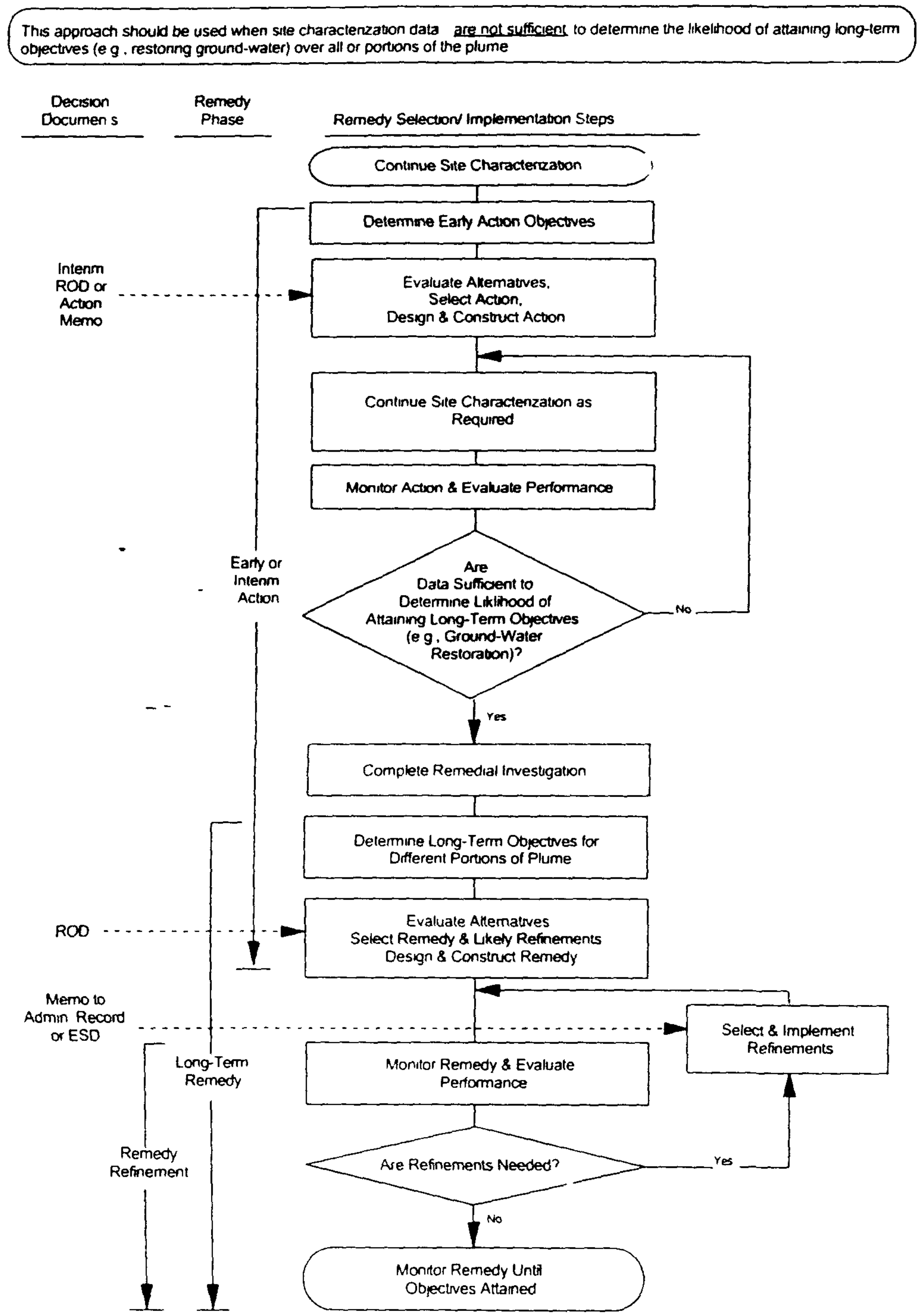
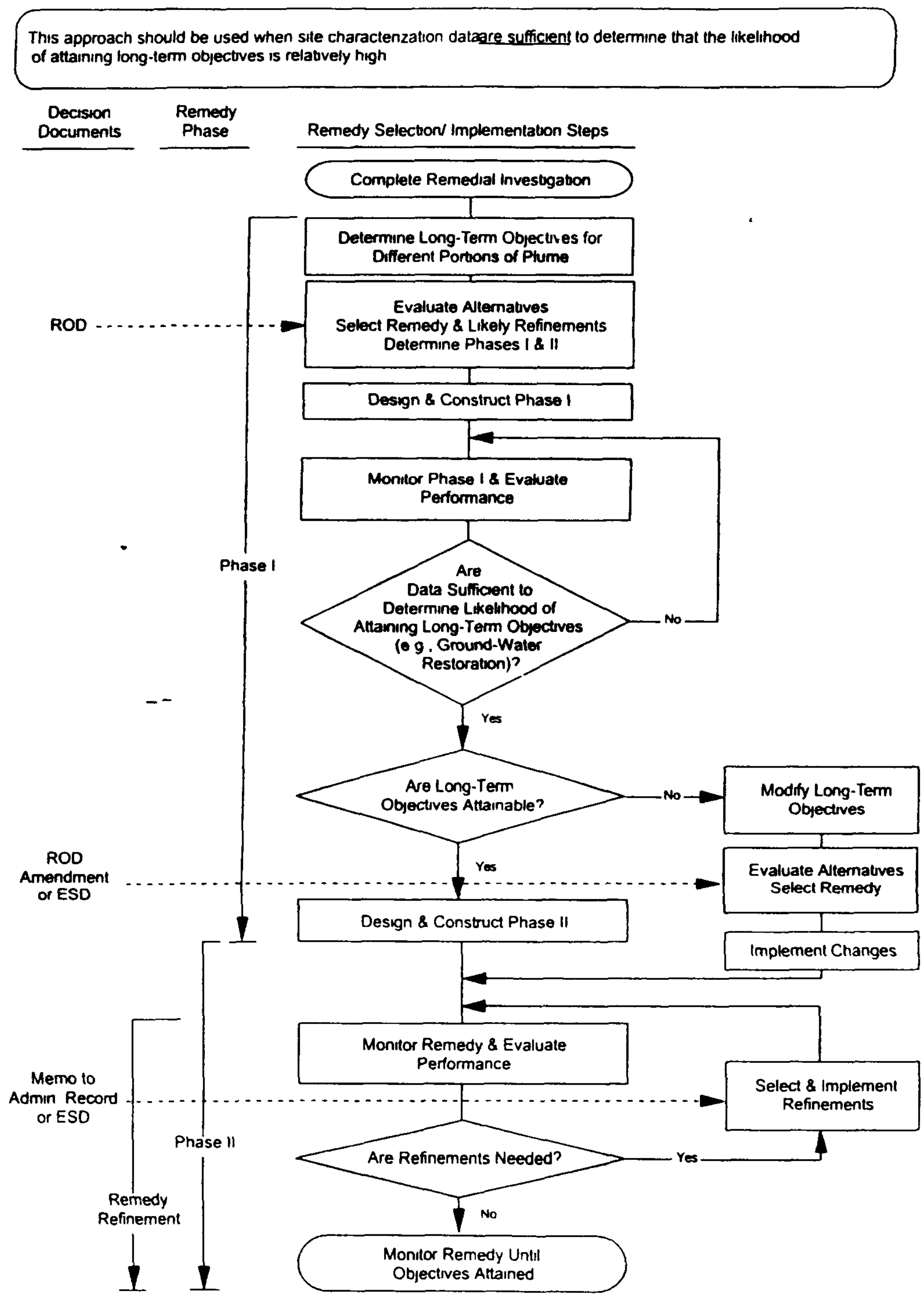


Figure 3 Phased Ground-Water Actions Long-Term Remedy Implemented in Phases



indicates that long-term objectives or other aspects of the remedy require modification, and the modified remedy differs significantly from the selected remedy *in terms of scope, performance or* cost (EPA, 1991a) **This approach should be used when site characterization data indicate that the likelihood of attaining long-term objectives is relatively high.**

When phased remedy implementation is specified in a ROD, the Agency should ensure that the proposed plan contains sufficient information regarding the nature, scope timing and basis of future decision points and alternatives that the public is able to evaluate and comment on the proposed remedy Example language illustrating how such an approach can be specified in the selected remedy portion of the ROD is included in Appendices B1 and B2 for hypothetical sites These examples follow the suggested ROD language given in EPA, 1990b, although the wording has been updated to reflect this and other recent guidance (EPA, 1993b) For comparison, suggested ROD language from the EPA, 1990b is included as Appendix B4

Phased implementation of a remedy can often be beneficial even for relatively simple ground-water actions For example, one extraction well could be installed as the initial phase and the performance of this well would be used to determine whether any additional wells are needed and whether long-term objectives need to be re-evaluated

Phased implementation of an extraction and treatment remedy will require that the treatment system be designed to accommodate phased installation of the extraction system Presumptive technologies for the treatment system and other design considerations are discussed in Section 3 Use of modular treatment components, which can be easily added or removed from the treatment system, may facilitate phased implementation or other changes in flow or contaminant concentration that may occur during the life of a remedy Another approach is to design the treatment system for the higher flows expected from all phases of the extraction system Some components of the remedy, such as buried portions of the piping distribution system, are *difficult to install in phases and should be* designed to carry the highest expected flows

2.3 Post-Construction Refinements

Even after phased implementation of a ground-water remedy, post-construction refinements will generally be needed because of the long time period over which the remedy will operate, especially for extraction and treatment remedies The refinement portion of the long-term remedy, after phased design and construction, is shown in both Figures 2 and 3

2.3.1 Types of Refinements. Post-construction refinements that should be considered for extraction and treatment remedies are given in Highlight 3 These refinements are intended to be relatively minor changes to the remedy (i e , for which an Explanation of Significant Differences (ESD) or ROD Amendment would generally **not** be required) For example, adding a new extraction or reinjection well, or a few additional monitoring wells should be considered a minor modification to a remedy that includes a relatively large number of such wells, because the overall scope, performance and cost of the remedy are not significantly changed (EPA, 1991a) One or more such refinements should generally be implemented when the results of a remedy evaluation indicate that they are needed to increase the performance of the remedy or to decrease the remediation timeframe

2.3.2 Documenting Refinements. Potential post-construction refinements should be included in the ROD as part of the selected remedy Listing specific remedy refinements in the ROD serves to communicate the anticipated full scope of the remedy to all concerned parties at an early date, and also minimizes the likelihood that a subsequent **ESD or ROD Amendment will be needed.** When remedy refinements are specified in a ROD, the Agency should ensure that the

Highlight 3. Remedy Refinements for Extraction/Treatment Remedies

- Change the extraction rate in some or all wells.
- Cease extraction from some wells.
- Initiate "pulsed pumping" (see Appendix A4).
- Add or remove extraction or reinjection wells, or drains.
- Add or remove monitoring wells.
- Refine source control components of remedy.
- Refine enhanced recovery or in-situ degradation components of remedy (see Note).
- Refine ex-situ treatment components

NOTE: A ground-water remedy could include both extraction and treatment and in-situ treatment methods.

proposed plan contains sufficient information regarding the nature, scope timing and basis of future decision points and alternatives that the public is able to evaluate and comment on the proposed remedy. Example ROD language specifying likely post-construction refinements for the extraction portion of the selected remedy is given in Appendices B1 and B2. Even if an ESD is not required, a letter or memorandum should be included in the post-ROD portion of the Administrative Record explaining the minor remedy modifications and the reasons for them. Additional information concerning documentation of remedy modifications can be found in the EPA fact sheet entitled *Guide to Addressing Pre-ROD and Post-ROD Changes* (EPA, 1991a).

2.4 Integrating Response Actions

In general, actions in response to contaminated ground water should be planned and implemented as part of an overall strategy. Earlier actions (see Highlight 2 for examples) should be compatible with and not preclude implementation of later actions. For example, permanent facilities should not be constructed which could interfere with possible later actions (e.g., structures that would interfere with later construction of extraction wells or of a cap).

2.4.1 Integrating Source Control and Ground-Water Actions. Restoration of contaminated ground water generally will not be possible unless contaminant sources have been controlled in some manner. Source control is a critical component for active restoration remedies (e.g., extraction and treatment and in-situ methods) as well as for natural attenuation (defined in Section 2.6.5). Selection of appropriate source control actions should consider whether other contaminant sources (i.e., NAPLs) are likely to be present in addition to contaminated soils. If NAPLs are present, the vast majority of contaminant mass will likely reside in the subsurface NAPLs rather than in the surficial soils. Therefore, for this case source control actions that are intended to minimize further contamination of ground water should focus on controlling migration of contaminants from the subsurface NAPLs. Also, capping or treatment of surficial soils may be needed to prevent exposure to contaminants from direct soil contact or inhalation, but these actions alone would be ineffective in preventing further contamination of ground water at sites where NAPLs are present.

2.4.2 Combining Ground-Water Restoration Methods. A remedy could include more than one method for restoring ground water to its beneficial uses, such as combining extraction and treatment with natural attenuation or in-situ-treatment with extraction and treatment. Extraction and treatment is especially useful for providing hydraulic containment of those portions of the plume where contaminant sources are present (e g , subsurface NAPLs or contaminated soils), or for containing or restoring those plume areas with relatively high concentrations of dissolved contamination ("hot spots") However, extraction and treatment may not be the best method for restoring large areas of the plume with low contaminant levels

Once source areas are controlled, natural attenuation may be able to restore large portions of the plume to desired cleanup levels in a timeframe that is reasonable (see Section 2.6.2) when compared with the timeframe and cost of other restoration methods. Thus, natural attenuation of some plume areas combined with extraction and treatment to contain source areas and/or plume "hot spots" may be the most appropriate restoration approach for many sites with relatively large, dilute plumes Whether or not natural attenuation is used alone or combined with other remediation methods, the Agency should have sufficient information to demonstrate that natural processes are capable of achieving the remediation objectives for the site EPA is currently preparing a directive that will provide more detailed discussion of EPA policy regarding the use of natural attenuation for remediation of contaminated ground water (EPA, 1996c)

By combining in-situ treatment and extraction and treatment methods it may be possible to significantly increase the effectiveness with which contaminants are removed from the aquifer In this guidance, in-situ treatment methods for ground water are divided into two types

- Methods that can be used to **enhance contaminant recovery** during extraction and treatment (e g , water, steam or chemical flooding, hydraulic or pneumatic fracturing), and

- Methods for **in-situ degradation of contaminants** generally involve adding agents to the subsurface (i e , via wells or treatment walls) which facilitate chemical or biological destruction, and have the potential to be used as an alternative to extraction and treatment for long-term restoration of ground water

Examples of both types of in-situ treatment methods are given in Appendix A3 Reinjection of treated ground water can be used as a method for enhancing contaminant recovery as well as a discharge method, if the reinjection is designed for this purpose as part of an extraction and treatment remedy When considering enhanced recovery methods for sites with subsurface NAPLs, potential risks of increasing the mobility of NAPLs should be evaluated Methods of in-situ degradation of contaminants most frequently used at Superfund sites include air sparging, various types of in-situ biological treatment and permeable treatment walls or gates (EPA, 1995e) Additional information concerning air sparging and permeable treatment walls is available in EPA, 1995f and EPA, 1995d, respectively EPA encourages the consideration, testing and use of in-situ technologies for ground-water remediation when appropriate for the site

2.5 Strategy for DNAPL Sites

Dense nonaqueous phase liquids (DNAPLs) pose special cleanup difficulties because they can sink to great depths in the subsurface, continue to release dissolved contaminants to the surrounding ground water for very long time periods, and can be difficult to locate Due to the complex nature of DNAPL contamination, a phased approach to characterization and response actions is especially important for sites where DNAPLs are confirmed or suspected A recent EPA study concluded that subsurface DNAPLs may be present at up to 60 percent of CERCLA National Priorities List sites (EPA 1993c) Refer to Appendix A1 for additional background information on DNAPLs

Two types of subsurface contamination can be defined at DNAPL sites, the

- DNAPL zone and the

- Aqueous contaminant plume

The **DNAPL zone** is that portion of the subsurface where immiscible liquids (free-phase or residual DNAPL) are present either above or below the water table. Also in the DNAPL zone, vapor phase DNAPL contaminants are present above the water table and dissolved phase below the water table. The **aqueous contaminant plume** is that portion of the contaminated ground water surrounding the DNAPL zone where aqueous contaminants derived from DNAPLs are dissolved in ground water (or sorbed to aquifer solids) and immiscible liquids are not present.

2.5.1 Site Characterization. If DNAPLs are confirmed or suspected, the remedial investigation (RI) should be designed to delineate the:

- Extent of aqueous contaminant plumes, and the
- Potential extent of DNAPL zones.

Methods and strategies for characterizing DNAPL sites as well as suggested precautions are discussed in other guidance (EPA, 1992a and 1994b) and by Cohen and Mercer, 1993 The reason for delineating these areas of the site is that response objectives and actions should generally be different for the DNAPL zone than for the aqueous contaminant plume. It is recognized that for some sites complete delineation of the DNAPL-zone may not be possible.

2.5.2 Early Actions. The early actions listed in Highlight 2 should be considered. Also, the following early actions are specifically recommended for DNAPL sites (EPA 1992b, 1993b):

- Prevent further spread of the aqueous plume (plume containment),
- Prevent further spread of hot spots in the aqueous plume (hot spot containment);
- Control further migration of contaminants from subsurface DNAPLs to the surrounding ground water (source control), and
- Red... the quantity of source material (free-phase DNAPL) present in the DNAPL zone, to the extent practicable (source removal and/or treatment).

At DNAPL sites, hot spots in the aqueous plume often are associated with subsurface DNAPLs. Therefore, the second and third actions listed above are essentially the same.

2.5.3 Long-Term Remedy. The long-term remedy should attain those objectives listed above for the **DNAPL zone**, by continuing early actions or by initiating additional actions. Although contaminated ground waters generally are not considered **principal threat** wastes, DNAPLs may be viewed as a principal threat because they are sources of toxic contaminants to ground water (EPA, 1991c). For this reason EPA expects to remove or treat DNAPLs to the extent practicable in accordance with the NCP expectation to "use treatment to address the principal threats posed by a site, wherever practicable" (Federal Register, 1990a; §300.430 (a)(1)(iii)(A)). However, program experience has shown that removal of DNAPLs from the subsurface is often not practicable, and no treatment technologies are currently available which can attain ARAR or risk-based cleanup levels where subsurface DNAPLs are present. **Therefore, EPA generally expects that the long-term remedy will control further migration of contaminants from subsurface DNAPLs to the surrounding ground water and reduce the quantity of DNAPL to the extent practicable.**

For the **aqueous plume**, the long-term remedy should:

- Prevent further spread of the aqueous plume (plume containment);

- Restore the maximum areal extent of the aquifer to those cleanup levels appropriate for its beneficial uses (aquifer restoration)

In general, restoration of the aquifer to ARAR or risk-based cleanup levels in a reasonable timeframe will not be attainable in the DNAPL zone unless the DNAPLs are removed. For this reason, it is expected that ARAR waivers due to technical impracticability will be appropriate for many DNAPL sites, over portions of sites where non-recoverable DNAPLs are present (EPA, 1995c) Also, EPA generally prefers to utilize ARAR waivers rather than ARAR compliance boundaries for such portions of DNAPL sites (see Section 2 6 4) A waiver determination can be made after construction and operation of the remedy or at the time of remedy selection (i e , in the ROD), whenever a sufficient technical justification can be demonstrated (EPA, 1993b EPA 1995b) For further information refer to Section 2 6 3 of this guidance and EPA's *Guidance for Evaluating the Technical Impracticability of Ground-Water Restoration* (EPA, 1993b) Restoration of the aqueous plume may also be difficult due to hydrogeologic factors, such as sorption of dissolved contaminants to solids in finer grained strata For some sites, ARAR waivers may also be appropriate for all or portions of the aqueous plume when supported by adequate justification

2.6 Areas of Flexibility in Cleanup Approach

The current response approach to contaminated ground water, as defined in the NCP and other guidance, includes several areas of flexibility in which response objectives and the timeframe in which to meet them can be adjusted to meet site specific conditions These are briefly discussed below

2.6.1 Beneficial Uses and ARARs. Since EPA generally expects to return contaminated ground waters to their beneficial uses wherever practicable the required cleanup levels for a given site should be determined from applicable or relevant and appropriate requirements (ARARs) based on the current and expected future beneficial uses of the ground water at that site Depending on state requirements and water quantity or quality characteristics, some ground waters are not expected to provide a future source of drinking water (e g , EPA Class III ground waters (EPA, 1986) or similar state designations) In general, drinking water standards are relevant and appropriate cleanup levels for ground waters that are a current or future source of drinking water, but are **not** relevant and appropriate for ground waters that are not expected to be a future source of drinking water (Federal Register, 1990a, Preamble at 8732) (Drinking water standards include federal maximum contaminant levels (MCLs) and/or non-zero maximum contaminant level goals (MCLGs) established under the Safe Drinking Water Act, or more stringent state drinking water standards) Ground waters may have other beneficial uses, such as providing base flow to surface waters or recharging other aquifers For contaminated ground waters that discharge to surface water, water quality criteria established under the Clean Water Act, or more stringent state surface water requirements, may also be cleanup level ARARs (Federal Register, 1990a, Preamble at 8754) Thus, the beneficial uses of contaminated ground water at a particular site will generally provide the basis for determining which federal or state environmental requirements are applicable or relevant and appropriate cleanup levels For additional information on the determination of cleanup levels refer to EPA, 1988b, Chapter 4

Determination of current and expected future beneficial uses should consider state ground-water classifications or similar designations Several states have developed ground-water use or priority designations as part of a Comprehensive State Ground Water Protection Program (CSGWPP), defined in EPA, 1992h EPA is currently developing a directive (EPA, 1996a) which will recommend that EPA remediation programs **should generally defer** to state determinations of future ground-water use -- even when this determination differs from the use that would otherwise have been determined by EPA -- when such determinations are

- Developed as part of an CSGWPP that is endorsed by EPA, and
- Based on CSGWPP provisions that can be applied at specific sites (EPA, 1996a)

This provision of the directive, when final, is intended to supersede previous guidance contained in the Preamble to the NCP (Federal Register, 1990a; at 8733). Refer to EPA, 1996a for additional information concerning the role of CSGWPPs in the selection of ground-water remedies. When information concerning beneficial uses is not available from a CSGWPP, ground-water classifications defined in EPA, 1986 (i.e., EPA Classes I, II or III) or "more stringent" state ground-water classifications (or similar state designations) should generally be used to determine the potential future use, in accordance with the NCP Preamble (Federal Register, 1990a, at 8732-8733). **Regardless of the ground-water use determination, remedies selected under CERCLA authority must protect human health and the environment and meet ARARs (or invoke an ARAR waiver).**

Many states have **antidegradation** or similar regulations or requirements that may be potential ARARs. Such requirements typically focus on 1) prohibiting certain discharges, 2) maintaining ground-water quality consistent with its beneficial uses, or 3) maintaining naturally occurring (background) ground-water quality Regulations of the third type do not involve determination of future ground-water use, and often result in cleanup levels that are more stringent than the drinking water standard for a particular chemical Such requirements are potential ARARs if they are directive in nature and intent and established through a promulgated statute or regulation that is legally enforceable (see Federal Register, 1990a, Preamble at 8746) For further information concerning issues related to state ground-water antidegradation requirements, refer to EPA, 1990a

2.6.2 Remediation Timeframe. "Remediation timeframes will be developed based on the specific site conditions" (Federal Register, 1990a, Preamble at 8732). Even though restoration to beneficial uses generally is the ultimate objective, a relatively long time period to attain this objective may be appropriate for some sites For example, an extended remediation timeframe generally is appropriate where contaminated ground waters are not expected to be used in the near term, and where alternative sources are available. In contrast, a more aggressive remedy with a correspondingly shorter remediation timeframe should generally be used for contaminated ground waters that are currently used as sources of drinking water or are expected to be utilized for this purpose in the near future (Federal Register, 1990a; at 8732). A state's CSGWPP may include information helpful in determining whether an extended remediation timeframe is appropriate for a given site, such as the expected timeframe of use, or the relative priority or value of ground-water resources in different geographic areas.

A **reasonable timeframe** for restoring ground waters to beneficial uses depends on the particular circumstances of the site and the restoration method employed. The most appropriate timeframe must be determined through an analysis of alternatives (Federal Register, 1990a; Preamble at 8732). The NCP also specifies that:

> "For ground-water response actions, the lead agency shall develop a limited number of remedial alternatives that attain site-specific remediation levels within different restoration time periods utilizing one or more different technologies" (Federal Register, 1990a, §300 430(e)(4))

Thus, a comparison of restoration alternatives from most aggressive to passive (i.e., natural attenuation) will provide information concerning the approximate range of time periods needed to attain ground-water cleanup levels. An excessively long restoration timeframe, even with the most aggressive restoration methods may indicate that ground-water restoration is technically impracticable from an engineering perspective (see Section 2 6 3) Where restoration is feasible using both aggressive and passive methods, the longer restoration timeframe required by a passive alternative may be reasonable in comparison with the timeframe needed for more aggressive restoration alternatives The most appropriate remedial option should be determined based on the nine remedy selection factors defined in the NCP (Federal Register, 1990a, §300 430 (e)(9)(iii)) Although restoration timeframe is an important consideration in evaluating whether restoration of ground water is technically impracticable, no single time period can be specified which would be considered excessively long for all site conditions (EPA, 1993b) For example, a restoration timeframe of 100 years may be reasonable for some sites and excessively long for others

2.6.3 Technical Impracticability. Where restoration of ground water to its beneficial uses is not practicable from an engineering perspective, one or more ARARs may be waived by EPA (or the lead agency) under the provisions defined in CERCLA §121(d)(4)(C)) The types of data used to make such a determination are discussed in *Guidance for Evaluating the Technical Impracticability of Ground-Water Restoration* (EPA, 1993b) Alternative remedial strategies, to be considered when restoration ARARs are waived, are also discussed in EPA, 1993b A finding of technical impracticability may be made in the Record of Decision (ROD) prior to remedy implementation, or in a subsequent decision document after implementation and monitoring of remedy performance

2.6.4 Point of Compliance. The area over which ARAR or risk-based cleanup levels are to be attained is defined in the NCP as follows

> "For ground water, remediation levels should generally be attained throughout the contaminated plume, or at and beyond the edge of the waste management area when waste is left in place" (Federal Register, 1990a, Preamble at 8713)

Thus, the edge of the waste management area can be considered as the point of compliance, because ARAR or risk-based cleanup levels are not expected to be attained in ground water within the waste management area In general, the term "waste left in place" is used in the NCP to refer to landfill wastes that, at the completion of the remedy, will be contained or otherwise controlled within a waste management area

For the purposes of ARAR compliance, EPA generally does not consider DNAPLs as "waste left in place" DNAPLs are typically not located in a waste management area, as envisioned in the NCP This is because the full extent of DNAPL contamination is often not known, DNAPLs can continue to migrate in the subsurface, and measures for controlling their migration are either unavailable or have uncertain long-term reliability Also, as discussed in Section 2 5 3, restoration of the aquifer to ARAR or risk-based cleanup levels generally will not be attainable in a reasonable timeframe unless the DNAPLs are removed **For these reasons, EPA generally prefers to utilize ARAR waivers rather than an alternate point of compliance over portions of sites where non-recoverable DNAPLs are present in the subsurface** (EPA, 1995c)

The NCP Preamble also acknowledges that "an alternative point of compliance may also be protective of public health and the environment under site-specific circumstances" (Federal Register, 1990a, at 8753) For example, where the contamination plume is "caused by releases from several distinct sources that are in close geographical proximity the most feasible and effective cleanup strategy may be to address the problem as a whole, rather than source by source and to draw the point of compliance to encompass the sources of release" (Federal Register, 1990a, at 8753) The NCP Preamble goes on to say that " where there would be little likelihood of exposure due to the remoteness of the site, alternate points of compliance may be considered provided contamination in the aquifer is controlled from further migration" (Federal Register, 1990a, at 8734) The Agency has not developed additional guidance on the use of alternate points of compliance at Superfund sites

2.6.5 Natural Attenuation. Natural attenuation is defined in the NCP as "biodegradation, dispersion, dilution, and adsorption" of contaminants in ground water (Federal Register, 1990a, Preamble at 8734) The NCP goes on to explain that natural attenuation may be a useful remedial approach if site-specific data indicate that these processes "will effectively reduce contaminants in the ground water to concentrations protective of human health [and the environment] in a timeframe comparable to that which could be achieved through active restoration " This approach differs from the "no action" alternative because natural attenuation is expected to attain cleanup levels in a reasonable timeframe (discussed in Section 2 6 2) The NCP recommends use of natural attenuation where it is "expected to reduce the concentration of contaminants in the ground water to the remediation goals [ARAR or risk-based cleanup levels] in a reasonable timeframe "

Natural attenuation may be an appropriate remedial approach for portions of the contaminant plume when **combined with other remedial measures** needed to control sources and/or remediate "hot spots" (also see Section 2 4 2) Whether or not natural attenuation is used alone or combined with other remediation methods, the Agency should have sufficient information to demonstrate that natural processes are capable of achieving the remediation objectives for the site One caution is that natural attenuation may not be appropriate for sites where contaminants biodegrade to intermediate compounds that are more toxic and degrade more slowly

Additional EPA policy considerations regarding the use of natural attenuation for remediation of contaminated ground water are provided in EPA, 1996c Although currently in draft, this EPA directive recommends that remedies utilizing natural attenuation should generally include 1) **detailed site characterization** to show that this approach will be effective, 2) **source control measures** to prevent further release of contaminants to ground water, 3) **performance monitoring** to assure that natural attenuation is occurring as expected, and 4) **institutional controls** and other methods to ensure that contaminated ground waters are not used before protective concentrations are reached Also, **contingency measures** may be needed in the event that natural attenuation does not progress as expected

2.6.6 Alternate Concentration Limits. Alternate concentration limits (ACLs) are intended to provide flexibility in establishing ground-water cleanup levels under certain circumstances In the Superfund program, EPA may establish ACLs as cleanup levels in lieu of drinking water standards (e g , MCLs) in certain cases where contaminated ground water discharges to surface water The circumstances under which ACLs may be established at Superfund sites are specified in CERCLA §121(d)(2)(B)(ii), and can be summarized as follows

- The contaminated ground water must have "known or projected" points of entry to a surface water body,
- There must be no "statistically significant increases" of contaminant concentrations in the surface water body at those points of entry, or at points downstream, and
- It must be possible to reliably prevent human exposure to the contaminated ground water through the use of institutional controls

Each of these criteria must be met and must be supported by site-specific information Such information also must be incorporated into the appropriate portions of the Administrative Record (e g the RI/FS and ROD)

The NCP Preamble also advises that ACLs not be used in every situation in which the above conditions are met, but only where active restoration of the ground water is "deemed not to be practicable" (Federal Register, 1990a; at 8754). This caveat in the Preamble signals that EPA is committed to the program goal of restoring contaminated ground water to its beneficial uses, except in limited cases. In the context of determining whether ACLs could or should be used for a given site, the term "practicability" refers to an overall finding of the appropriateness of ground-water restoration, based on an analysis of remedial alternatives using the Superfund remedy selection criteria, especially the "balancing" and "modifying" criteria (EPA, 1993b). (These criteria are defined in part §300.430(e)(9)(iii) of the NCP (Federal Register, 1990a.) This is distinct from a finding of "technical impracticability from an engineering perspective," which refers specifically to an ARAR waiver and is based on the narrower grounds of engineering feasibility and reliability with cost generally not a major factor, unless ARAR compliance would be inordinately costly (see Section 2.6.3 and EPA, 1993b) Where an ACL is established, such an ARAR waiver is not necessary Conversely, where an ARAR is waived due to technical impracticability, there is no need to establish CERCLA ACLs, as defined above When establishing an ACL, a detailed site-specific justification should be provided in the Administrative Record which documents that the above three conditions for use of ACLs are met, and that restoration to ARAR or risk-based levels is "not practicable" as discussed above

Although alternate concentration limits are also defined in the RCRA program, users of this guidance should be aware of **several important differences in the use of ACLs by the RCRA and Superfund programs**. For "regulated units" (defined in 40 CFR 264 90) ACLs are one of the three possible approaches for establishing concentrations limits of hazardous constituents in ground water. Those options are described in 40 CFR 294.94(a). Factors considered when determining whether an ACL is appropriate for a particular facility are provided in 40 CFR 264 94(b). The use of RCRA ACLs is not strictly limited to cases where contaminated ground water discharges to surface water, or to cases where ground-water restoration is considered "not practicable" (as is the case in Superfund). However, the factors considered in the RCRA ACL decision are meant to ensure that establishment of ACLs will be protective of human health and the environment.

A specific reference to ACLs is not made in the existing framework for implementing RCRA Corrective Action at "non-regulated units" (Federal Register, 1990b and 1996). However, the Corrective Action framework recommends flexibility for the development and use of risk-based cleanup standards, based on considerations similar to those used for establishing ACLs under 40 CFR 264.94.

3.0 PRESUMPTIVE TECHNOLOGIES

3.1 Presumptive Technologies for Ex-Situ Treatment

Presumptive technologies for the treatment portion of an extraction and treatment remedy (ex-situ treatment) are identified in Highlight 4. Descriptions of each of the presumptive technologies are presented in Appendices D1 through D8. These technologies are presumptive for treatment of **contaminants dissolved** in ground water that has been extracted from the subsurface, and are expected to be used for this purpose at "all appropriate sites." (Refer to the Preface of this guidance and EPA, 1993d for further information concerning the Agency's expectations concerning the use of presumptive treatment technologies)

Highlight 4. Presumptive Technologies For Treatment Of Extracted Ground Water

For treatment of dissolved **organic contaminants**, volatiles, semivolatiles and others (see Note):

- Air stripping
- Granular activated carbon (GAC)
- Chemical/UV oxidation (for cyanides also)
- Aerobic biological reactors

For treatment of dissolved **metals**

- Chemical precipitation
- Ion exchange/adsorption
- Electrochemical methods (when only metals are present)
- Aeration of background metals

For treatment of **both organic and inorganic constituents**:

- A combination of the technologies listed above

NOTE: A given treatment train could include a combination of one or more of the presumptive technologies for treatment of **dissolved** contaminants as well as other technologies for other purposes (e g , separation of solids) as indicated in Appendix C2

3.1.1 Design Styles within Presumptive Technologies. The presumptive technologies identified in Highlight 4 refer to technology types rather than specific designs (design styles) Each presumptive technology represents a single process falls within one of these technology types (e g , innovative air stripper designs, or innovative media for ion exchange/adsorption of metals) A listing of design styles of the presumptive technologies typically considered during Superfund remedy selection are listed in Appendix C1

3.1.2 Benefits of Presumptive Technologies. Use of the presumptive technologies identified in this guidance will simplify and streamline the remedy selection process for the ex-situ treatment portion of a ground-water remedy by:

- Simplifying the overall selection process, since the large number and diverse assortment of these technologies have been reduced to relatively few technology types,
- Eliminating the need to perform the technology screening portion of the feasibility study (FS), beyond the analysis contained in this guidance and its associated Administrative Record (See Section 3 3 2),
- Allowing, in some cases, further consideration and selection among the presumptive technologies to be deferred from the FS and ROD to the remedial design (RD), which prevents duplication of effort and allows selection to be based on additional data collected during the RD (see Section 3 3 3),
- Shifting the time and resources employed in remedy selection from ex-situ treatment to other, more fundamental aspects of the ground-water remedy (see Section 1 0), and
- Facilitating the use of extraction and treatment for early actions, where appropriate, since selection of the treatment component is simplified

3.1.3 Consideration of Innovative Technologies. Use of presumptive technologies for treatment of extracted ground water is intended to simplify the remedy selection process, but does not preclude the consideration of innovative technologies for this purpose in the FS or RD. Refer to the EPA fact sheet, *Presumptive Remedies: Policy and Procedures* (EPA, 1993d), for additional information. Many innovative or emerging technologies for ex-situ treatment are actually design variations of one of the presumptive technology types, as discussed above, and others may be considered on a site-specific basis. In addition, EPA encourages consideration of in-situ treatment technologies for ground-water remedies, either when combined with extraction and treatment or as an alternative to such methods (see Section 2.4.2).

3.2 Basis for Presumptive Technologies

3.2.1 Sources of Information. Three sources of information were used to determine which technologies should be identified as presumptive for ex-situ treatment of ground water:

- Review of the technologies selected in **all RODs** signed from fiscal years 1982 through 1992;
- Review of capabilities and limitations of ex-situ treatment technologies from engineering and other technical literature; and
- Detailed evaluation of the technologies considered in the FS and selected in the ROD or RD for a sample of 25 sites for which at least one ex-situ treatment technology was selected.

The above information is summarized in a separate report entitled *Analysis of Remedy Selection Results for Ground-Water Treatment Technologies at CERCLA Sites* (EPA, 1996b). A total of 427 RODs selected at least one ex-situ technology for treatment of ground water, as of September 30, 1992. From these RODs, a sample of 25 sites were selected for detailed evaluation of the rationale used to select these technologies as part of the ground-water remedy.

3.2.2 Rationale for Indentifying Presumptive Technologies. At least one of the eight presumptive technologies, identified in Highlight 4, was selected as part of the ground-water remedy in 425 of 427 RODs, or **99.5 percent** of the time. In only five RODs were technologies other than the presumptive technologies selected as part of the treatment train. Therefore, presumptive technologies were the **only** technologies selected for ex-situ treatment of dissolved ground-water contaminants in 420 of the 427 RODs.

More importantly, all the presumptive technologies are well understood methods that have been used for many years in the treatment of drinking water and/or municipal or industrial wastewater. Engineering Bulletins or Technical Data Sheets have been developed by EPA and the Naval Energy and Environmental Support Activity, respectively, for five of the eight presumptive technologies. These publications generally include site specific performance examples, and are included as references, along with other publications, with the description of each technology in Appendix D.

In the 25 site sample, the presumptive technologies, identified in Highlight 4, were the **only** technologies selected in the ROD for **all** sites and the only technologies implemented in the RD for 24 sites. Other technologies were consistently eliminated from further consideration, usually in the technology screening step, based on technical limitations which were verified by the engineering literature. As part of this evaluation the large number and diverse assortment of technologies considered for ex-situ treatment of ground water were categorized according to the underlying treatment process. A complete listing of the technologies considered in the FS, ROD or RD for the 25 sites is given in Appendix C1, categorized by process type and with the presumptive technologies identified.

Some technologies are identified as presumptive even though they were selected in relatively few RODs. **Aeration of background metals** was identified as presumptive because this technology is often used for removal of iron and manganese, and was considered and selected for this purpose at two of the 25 sample sites **Electrochemical methods** for metals removal were also identified as presumptive because these methods were considered at all three sample sites where metals were the only contaminants of concern, and were selected at two of these sites **Chemical/UV oxidation** and **aerobic biological reactors** were identified as presumptive technologies for treating organic contaminants for the following technical reasons

- A range of chemical, physical and biological treatment methods should be included in the presumptive technologies, because air stripping and granular activated carbon, alone or combined, may not provide cost effective treatment (see Section 3 4 5) for all organic contaminants

- These methods destroy organic contaminants as part of the treatment process instead of transferring them to other media, which reduces the quantity of hazardous treatment residuals (e g , spent carbon) that will require further treatment

- Ongoing research and development efforts, by EPA and others, are expected to increase the cost effectiveness of these treatment methods

3.3 Remedy Selection Using Presumptive Technologies

Selection of technologies for long-term treatment of extracted ground water requires an understanding of the types of technologies that will be needed, how they will be used in the treatment system and site-specific information for determining the most appropriate and cost-effective technologies **The presumptive technologies for treating dissolved contaminants in extracted ground water, identified in Highlight 4, are the technologies that should be retained for further consideration in the Detailed Analysis portion of the feasibility study (FS).** This guidance and its associated Administrative Record will generally constitute the Development and Screening of Alternatives portion of the FS for the ex-situ treatment component of a ground-water remedy, as discussed in Section 3.3 2

Site information needed to select cost-effective treatment technologies (see Section 3 .4) is often not collected until the remedial design (RD) phase **In such cases, it will generally be appropriate to specify performance requirements for the treatment system in the ROD, but defer selection of specific technologies until the RD,** as discussed in Section 3 3 3

3.3.1 Use of Technologies in Treatment Systems. Complete treatment of extracted ground water generally requires that units of more than one technology, or multiple units of a single technology (unit processes), be linked together in a treatment train A given treatment train could include some combination of treatment technologies for the following purposes

1. Separation of mineral solids and/or immiscible liquids from the extracted ground water during initial treatment (pretreatment),

2. Treatment of **dissolved contaminants**,

3. Treatment of vapor phase contaminants from the extracted ground water or those generated during treatment,

4. Separation of solids generated during treatment,

5. Final treatment of **dissolved contaminants** prior to discharge (polishing), and

6. Treatment of solids generated during treatment

Presumptive technologies for treatment of **dissolved contaminants** in extracted ground water (No 2 and 5, above) are identified in Highlight 4 Examples of the types of technologies used for other purposes are given in Appendix C2, along with a listing of the general sequence of unit processes used in a treatment train Solid residuals (such as sludges from chemical or biological processes, or spent carbon media) will generally require additional treatment or disposal, either as part of the treatment train or at a separate facility Presumptive technologies for purposes other than for treatment of dissolved contaminants have **not** been identified in this guidance

Use of modular treatment components, which can be easily added or removed from the treatment system, may facilitate phased implementation or other changes that may occur during the life of a remedy. Phased implementation of the extraction portion of a remedy may require that some components of the treatment system also be installed in stages Also, modification of the treatment system over time may be needed in response to changes in the inflow rate or contaminant loadings, or to increase the effectiveness or efficiency of the treatment system

3.3.2 This Guidance Constitutes the FS Screening Step. This guidance and its associated Administrative Record will generally constitute the "development and screening of alternatives" portion of the feasibility study (FS), for the ex-situ treatment component of a ground-water remedy When using presumptive technologies, the FS should contain a brief description of this approach (see fact sheet entitled *Presumptive Remedies Policy and Procedures* (EPA, 1993d)), and refer to this guidance and its associated Administrative Record Such a brief description should fulfill the need for the development and screening of technologies portion of the FS for the ex-situ treatment component of the remedy

3.3.3 Deferral of Final Technology Selection to RD. Although EPA prefers to collect the site information needed for technology selection prior to the ROD, it is sometimes impracticable to collect some of the necessary information until the remedial design (RD) phase (See Section 3.4 for a summary of site information generally needed for selection of these technologies) In reviewing remedy selection experience for a sample of sites, EPA found that at seven of 25 sites (28 percent) the type of technology selected in the ROD for treatment of extracted ground water was later changed in the RD because of additional site information obtained during the design phase (EPA, 1996b) Where EPA lacks important information at the ROD stage, it may be appropriate to defer final selection among the presumptive ex-situ treatment technologies (as well as selection of specific design styles) to the RD phase

In this approach, EPA would identify and evaluate the technologies and provide an analysis of alternative technologies in the FS (this guidance and its associated administrative record will generally constitute that discussion) The proposed plan would identify the technologies that may be finally selected and specify the timing of and criteria for the future technology selection in sufficient detail that the public can evaluate and comment on the proposal The ROD would also identify all ARARs and other performance specifications and information associated with discharge and treatment of the extracted ground water, including the types of discharge, effluent requirements, and specifications developed in response to community preferences Specifying the performance criteria and other requirements in the ROD (using a type of "performance based approach") ensures that the remedy will be protective and meet ARARs Overall, the ROD should be drafted so that the final selection of technologies at the RD phase follows directly from the application of criteria and judgments included in the ROD to facts collected during the RD phase If the ROD is drafted in this fashion, documenting the final technology selection can generally be accomplished by including a document in the post-ROD portion of the Administrative Record, which explains the basis of technology selection (e g , Basis of Design Report, or memorandum to the RD file)

Advantages of deferring selection of ex-situ treatment technologies to the RD include

- The remedy selection process is further streamlined, since final selection and the accompanying detailed analysis for these technologies is performed only in the RD not in both the FS and the RD, minimizing duplication of effort,
- Site information collected during the RD can be used to make final technology selections as well as to design the treatment train, which facilitates selection of the most cost effective technologies (see Section 3 4 5),
- The likelihood that changes in the treatment train will be made during the RD is explicitly recognized in the ROD, and
- The time and resources employed in the FS can focus on other components of the ground-water remedy that have more direct influence on attainment of **remedial objectives** for contaminated ground water (see Section 1 0)

Cost estimates for remedial alternatives, including the ex-situ treatment component, will need to be included in the FS regardless of whether or not technology selection is deferred to the RD For cost estimating purposes when deferring technology selection to the RD, reasonable assumptions should be made concerning the treatment system, including assumptions concerning the presumptive technologies and likely design styles to be used To assist in making such assumptions, advantages and limitations for the presumptive technologies are summarized in Appendix C4 Also, brief descriptions of the presumptive technologies and references for additional information are provided in Appendix D Assumptions used for estimating treatment costs should be consistent across all remedial alternatives All assumptions should be clearly stated as such in the FS and ROD

Example ROD language for deferring technology selection to the RD is given in Appendix B3 for a hypothetical site This language is only for the ex-situ treatment portion of an extraction and treatment remedy and should appear in the selected remedy portion of the ROD when following this approach

3.4 Information Needed for Selecting Technologies

The site information listed in Highlight 5 is generally needed to determine the treatment components of a complete treatment train for extracted ground water and to select the most appropriate technology type and design style for each component Further detail regarding site data needed and the purpose of this information is provided in Appendix C3 Much of this information is also needed for design of the extraction component of an extraction and treatment remedy

3.4.1 When Should this Information be Collected? The information listed in Highlight 5 is needed for design of the treatment train Therefore, it must be collected prior to or during the design phase, for either an early action or long-term remedy Much of this information should also be available for selecting among the presumptive technologies, since it is generally needed to determine the technologies most appropriate for site conditions The timing of information needed during remedy selection is different when deferring technology selection to the RD than when selecting technologies in the ROD, as discussed in Section 3 3 3 However, much of this information can be collected along with similar data gathered during the remedial investigation (RI) In general, it is recommended that as much of this information as possible be obtained prior to the RD in order to minimize the

Highlight 5. Summary of Site Information Needed For Treatment Train Design

- Total extraction flow rate
- Discharge options and requirements
  - Target effluent concentrations
    - Contaminants
    - Degradation products
    - Treatment additives
    - Natural constituents
  - Other requirements
    - Regulatory
    - Operational
  - Community concerns or preferences
- Water quality of treatment influent
  - Contaminant types and concentrations
  - Naturally occurring constituents
  - Other water quality parameters
- Treatability information

NOTE Further detail is provided in Appendix C3

need for additional site investigations during the RD and to accelerate the RD phase
much of this information can be collected along with similar data gathered during the remedial investigation (RI) In general, it is recommended that as much of this information as possible be obtained prior to the RD in order to minimize the need for additional site investigations during the RD and to accelerate the RD phase

3.4.2 Extraction Flow Rate Inflow to the treatment system is the total flow from all extraction wells or drains Estimates of total extraction flow rate often have a **high degree of uncertainty** (i e , one or more orders of magnitude), depending on type of data and estimation method used Expected flow rates from extraction wells are typically estimated from hydraulic properties of the aquifer Aquifer hydraulic properties may have considerable natural variation over the site and accurate measurement of these properties is often difficult In order to reduce uncertainty during design of the treatment system, **aquifer properties used in estimating the inflow should generally be obtained from pumping-type aquifer tests** and not from "slug tests," laboratory measurements on borehole samples or values estimated from the literature

Pumping-type aquifer tests provide a much better estimate of average aquifer properties than other methods, because a much larger volume of aquifer is tested For the same reason, ground water extracted during pumping tests is more representative of that which will enter the treatment system, and should generally be used for treatability studies of ex-situ treatment technologies instead of samples obtained from monitoring wells Suggested procedures for conducting pumping-type aquifer tests are given in EPA, 1993i Methods for treatment of contaminated ground water extracted during pumping-type aquifer tests are discussed in Section 3 5

The likely variability in the total extraction rate during the life of the remedy should also be estimated Variability in the extraction rate could result from addition or removal of extraction wells, short-term operational changes in the system (e g , changing the pumping rates) or seasonal fluctuations in the water table The number of extraction wells could change as a result of implementing the remedy in phases or from post-construction refinement of the remedy (see Section 2 3 1)

3.4.3 Discharge Options and ARARs. All options for discharge of ground water after extraction and treatment should be identified and considered in the FS, especially options that include re-use or recycling of the extracted ground water. Water quality requirements for the treated effluent (i.e., effluent ARARs) may be different for each discharge option. Examples of regulatory requirements include those promulgated under the federal Safe Drinking Water Act and Clean Water Act, which would apply to discharges to a drinking water system or to surface waters, respectively; and state requirements for these types of discharge. Effluent requirements could also include those for chemicals added during treatment, contaminant degradation products, and naturally occurring constituents (e.g., arsenic), in addition to those for contaminants of concern. **In general, one or more types of discharge for extraction and treatment remedies should be selected in the ROD, not deferred to the RD.** ARARs for the treated effluent will determine the overall level of treatment needed, which in turn determines the type of components needed in the treatment train (see Section 3.3.1) and is a critical factor in selecting appropriate treatment technologies.

In some cases it may be appropriate to select more than one type of discharge for the selected remedy. One type of discharge may be preferred, but may not be capable of accepting the entire flow of treated effluent. For example, it may be possible to re-use or recycle a portion but not all of the discharge. It may also be desirable to reinject a portion of the treated effluent for enhanced recovery of contaminants (aquifer flushing) but prohibitively costly to reinject the entire discharge

In addition to the types of discharge, ARARs and other specifications related to technology selection or operating performance of the treatment system should be specified in the ROD. Regulatory requirements for all waste streams from the treatment system should be specified, including those for the treated effluent; releases to the air, and those for handling, treatment and disposal of solid and liquid treatment residuals. Other specifications could include those preferred by the affected community, such as requirements to capture and treat contaminant vapors (even though not required by ARARs) or limits on operating noise. Other specifications may also be needed to maintain continued operation of the system, such as water quality conditions necessary to minimize chemical and/or biological clogging of injection wells or drains.

3.4.4 Water Quality of Treatment Influent. In order to design the treatment system, contaminant types and concentrations and other water quality parameters must be estimated for the total flow entering the system. Since some technologies are more effective than others in removing certain contaminant types, this is an important technology selection factor. Concentrations of naturally occurring constituents as well as background and site-related contaminants in the extracted ground water should also be measured, as discussed in Appendix C3.

3.4.5 Treatability Studies. Treatability studies involve testing one or more technologies in the laboratory or field to assess their performance on the actual contaminated media to be treated from a specific site. These studies may be needed during the RI/FS to provide qualitative and/or quantitative information to aid in selection of the remedy, or during the RD to aid in design or implementation of the selected remedy Three tiers of testing may be undertaken: 1) laboratory screening, 2) bench-scale testing, or 3) pilot-scale testing. Treatability studies may begin with any tier and may skip tiers that are not needed (EPA, 1989c)

For treatment of extracted ground water, treatability studies are generally needed to accurately predict the effectiveness and total cost of a technology for a given site, including construction and operating costs; and the costs of other components that may be needed in the treatment train (see Section 3 3 1) Optimizing the cost effectiveness of the treatment train is especially important for systems designed to operate over a long time period (In this guidance, optimizing the cost effectiveness of the treatment system is defined as meeting all treatment and other performance requirements while minimizing total costs per unit volume of water treated.) Treatability studies may also indicate that some technologies provide cost effective treatment when all of the above factors are considered, even though these technologies were infrequently selected in past RODs (e.g., chemical/UV oxidation or aerobic biological reactors). For these reasons treatability studies will be helpful in selecting among the presumptive technologies. Similarly, a presumptive treatment technology should **not** be eliminated from further consideration in the FS or RD simply because a treatability study is required to determine its applicability for a given site. In general, some type of treatability study should be performed prior to or during the design of any system expected to provide **long-term treatment** of extracted ground water, including systems using presumptive technologies.

3.5 Treatment Technologies for Aquifer Tests

Although pumping-type aquifer tests are the preferred method of determining average aquifer properties (see Section 3.4.2) and this information is useful for remedy selection, such testing is often deferred to the RD phase because of the need to determine how to treat and/or dispose of the extracted ground water. To facilitate use of such tests earlier in the site response, ex-situ treatment technologies most suitable for this application are discussed below.

3.5.1 Treatment Needs during Aquifer Tests. In comparison to an extraction and treatment remedy, pumping-type aquifer tests (see Section 3.4.2) generate relatively small flows of contaminated ground water over a short period of time. At the time of such tests, the estimated pumping rates and contaminant loadings generally have a high degree of uncertainty. Often the total volume of ground water extracted during testing is held in storage tanks or lined ponds to prevent the discharge from affecting water levels in observation wells and interfering with the test. Storage of the extracted ground water also allows subsequent flow to a treatment system to be controlled and optimized. For example, if storage vessels are used for both the untreated and treated water, the [illegible]cted water can be routed through the treatment system as many times as necessary to meet discharge and/or disposal requirements. Therefore, the cost effectiveness of treatment technologies (see Section 3.4.5) is less important for aquifer testing than for the long-term remedy, because of the much smaller volume of ground water to be treated and the much shorter period of operation.

3.5.2 Treatment Technologies for Aquifer Tests. Technologies for treating ground water extracted during aquifer tests should be able to treat a wide range of contaminant types, be available in off-the-shelf versions (short lead time for procurement), have a short on-site startup time, be relatively simple to operate, and be available in easily transportable units. Of the presumptive technologies identified above, the three most suitable for this application are:

- Granular activated carbon,
- Air stripping, and
- Ion exchange/adsorption.

Granular activated carbon can effectively remove most dissolved organic contaminants and low concentrations of some inorganic compounds. Ion exchange/adsorption can remove most metals. Air stripping may be applicable for volatile organic contaminants (VOCs) and generally is more cost effective than granular activated carbon for treating VOCs when flow rates are greater than about three gallons per minute (Long, 1993). Granular activated carbon may still be needed in conjunction with air stripping, for treating dissolved semivolatile organic contaminants, or for reaching stringent effluent requirements for VOCs. Granular activated carbon may also be needed for treatment of vapor phase contaminants separated by an air stripper. Also, treatability studies generally are not required for the above three technologies, especially for **short-term** applications. Additional information regarding the availability and field installation of skid or trailer mounted treatment units (package plants) is available in EPA, 1995a

Other presumptive ex-situ treatment technologies (chemical/UV oxidation, aerobic biological reactors, chemical precipitation, and electrochemical methods) generally are less suitable for aquifer testing purposes. In general, these other technologies require longer lead times for procurement and longer time on-site for startup; and have more complex operating requirements and higher capital costs

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Appendix A1: Background on DNAPL Contamination

DNAPL Background

A **nonaqueous phase liquid** (NAPL) is a chemical that is a liquid in its pure form, which does not readily mix with water but does slowly dissolve in water. **Dense NAPLs (DNAPLs)** sink while **light NAPLs (LNAPLs)** float in water. When present in the subsurface NAPLs slowly release vapor and dissolved phase contaminants, resulting in a zone of contaminant vapors above the water table and a plume of dissolved contaminants below the water table. The term NAPL refers to the undissolved liquid phase of a chemical or mixture of compounds and not to the vapor or dissolved phases. NAPLs may be present in the subsurface as either **"free-phase"** or as **"residual-phase."** The free-phase is that portion of NAPL that can continue to migrate and which can flow into a well. The residual-phase is that portion trapped in pore spaces by capillary forces, which can **not** generally flow into a well or migrate as a separate liquid. Both residual and free-phase NAPLs are sources of vapors and dissolved contaminants.

LNAPLs tend to pose less of a cleanup problem than DNAPLs. The most common LNAPLs are petroleum fuels, crude oils and related chemicals, which tend to be associated with facilities that refine, store or transport these liquids. Since LNAPLs tend to be shallower, are found at the water table and are associated with certain facilities, they are generally easier to locate and clean up from the subsurface than DNAPLs.

DNAPLs pose much more difficult cleanup problems. These contaminants include chemical compounds and mixtures with a wide range of chemical properties, including chlorinated solvents, creosote, coal tars, PCBs, and some pesticides. Some DNAPLs, such as coal tars, are viscous chemical mixtures that move very slowly in the subsurface. Other DNAPLs, such as some chlorinated solvents, can travel very rapidly in the subsurface because they are heavier and less viscous than water. A large DNAPL spill not only sinks vertically downward under gravity, but can spread laterally with increasing depth as it encounters finer grained layers. These chemicals can also contaminate more than one aquifer by penetrating fractures in the geologic layer which separates a shallower from a deeper aquifer. Thus, large releases of DNAPLs can penetrate to great depths and can be very difficult to locate and clean up.

The contamination problem at DNAPL sites has two different components, as shown in **Figures A1-1 and A1-2**, the:

- DNAPL zone, and the
- Aqueous contaminant plume.

The **DNAPL zone** is that portion of the subsurface where immiscible liquids (free-phase or residual DNAPL) are present either above or below the water table. Also in the DNAPL zone, vapor phase DNAPL contaminants are present above water table and dissolved phase below water table. The **aqueous contaminant plume** is that portion of the contaminated ground water surrounding the DNAPL zone where aqueous contaminants derived from DNAPLs are dissolved in ground water (or sorbed to aquifer solids) but immiscible liquids are **not** present. Depending on the volume of the release and subsurface geology, the DNAPL zone may extend to great depths and over large lateral distances from the entry location, as discussed above.

Figure A1-1: Components of DNAPL Sites

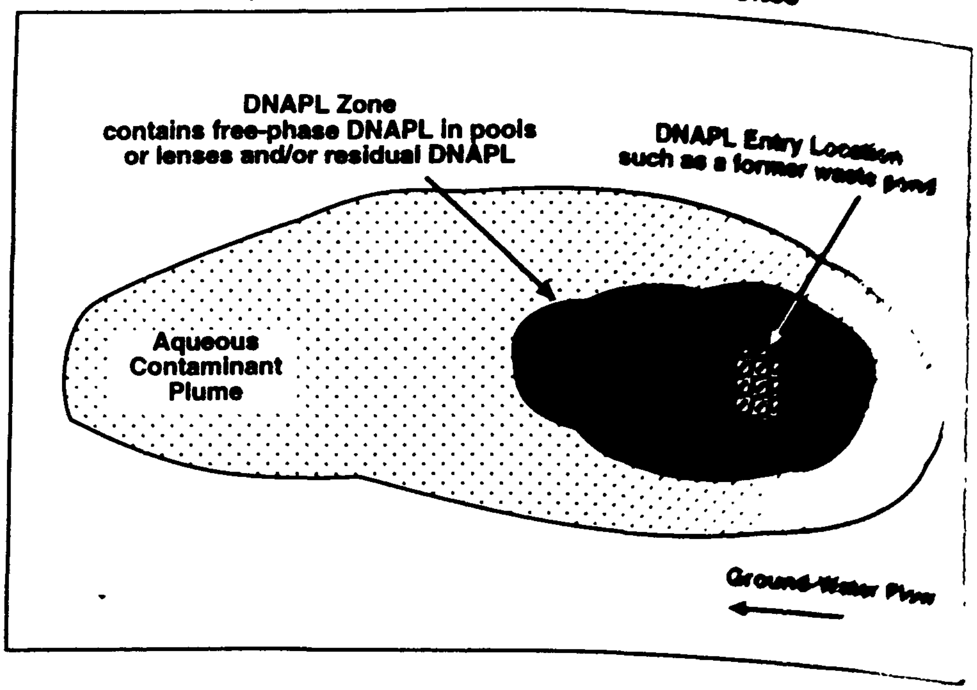
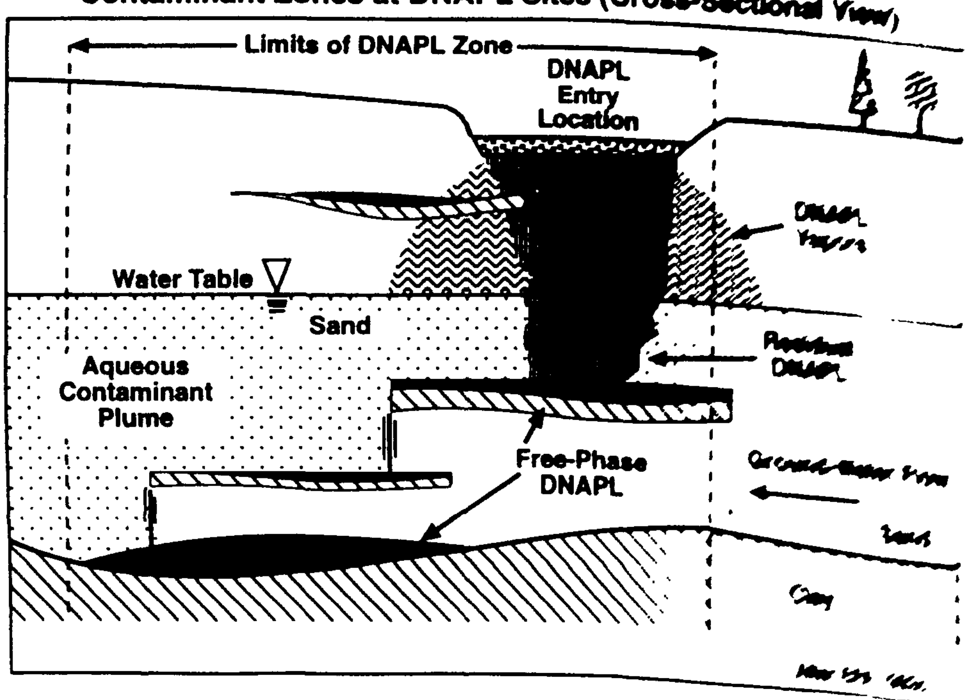


Figure A1-2: Types of Contamination and Contaminant Zones at DNAPL Sites (Cross-Sectional View)



Appendix A2: Contaminants Most Frequently Reported in Ground Water at CERCLA NPL Sites[1]

Organic Contaminants:

Rank	Organic Contaminants (Other Names)	Chemical[2] Group	Halo-[2] genated?	DNAPL?[3]	No.[1] Sites
1	Trichloroethylene, 1,1,2- (TCE)[a]	Volatile	Yes	Yes	336
2	Tetrachloroethene (perchloroethene; PCE)[a]	Volatile	Yes	Yes	170
3	Chloroform (trichloromethane)[a]	Volatile	Yes	Yes	167
4	Benzene[b]	Volatile	No	No	164
5	Toluene[b]	Volatile	No	No	159
6	Trichloroethane, 1,1,1- (methyl chloroform; 1,1,1-TCA)[a]	Volatile	Yes	Yes	155
7	Polychlorinated biphenyls	PCB	Yes	Yes	139
8	Trans-Dichloroethylene, 1,2- (trans-1,2-DCE)[a]	Volatile	Yes	Yes	107
9	Dichloroethane, 1,1- (1,1-DCA)[a]	Volatile	Yes	Yes	105
10	Dichloroethene, 1,1- (vinylidene chloride; 1,1-DCE)[a]	Volatile	Yes	Yes	95
11	Vinyl chloride (chloroethylene)[a]	Volatile	Yes	No	82
12	Xylene[b]	Volatile	No	No	76
13	Ethylbenzene[b]	Volatile	No	No	68
14	Carbon tetrachloride (tetrachloromethane)[a]	Volatile	Yes	Yes	68
15	Phenol	Semivol.	No	No	61
16	Methylene chloride (dichloromethane)[a]	Volatile	Yes	Yes	58
17	Dichloroethane, 1,2- (ethylene dichloride; 1,2-DCA)[a]	Volatile	Yes	Yes	57
18	Pentachlorophenol (PCP)	Semivol.	Yes	Yes	53
19	Chlorobenzene (benzene chloride)[a]	Volatile	Yes	Yes	48
20	Benzo(A)Pyrene	Semivol.	No	Yes	37

Appendix A2: Contaminants Most Frequently Reported in Ground Water at CERCLA NPL Sites (continued)[1]

Inorganic Contaminants:

Rank	Inorganic Contaminants	No.[1] Sites
1	Lead	307
2	Chromium and compounds	215
3	Arsenic	147
4	Cadmium	127
5	Mercury[4]	81
6	Copper and compounds	79
7	Zinc and compounds	73
8	Nickel and compounds	44
9	Cyanides (soluble salts)	39
10	Barium	37

NOTES:

1 Number of CERCLA National Priorities List (NPL) sites for which the chemical was reported in ground water as a contaminant of concern in the Superfund Site Assessment, for either proposed or final NPL sites. This data was obtained from the Superfund NPL Assessment Program (SNAP) data base, as of August 30, 1994. At that time total of 1294 sites were listed on the NPL (64 proposed and 1230 final).

2 Classification of organic contaminants as volatile, semivolatile, PCB, or pesticide; and as halogenated or nonhalogenated is from EPA Publication, "Technology Screening Guide for Treatment of CERCLA Soils and Sludges," EPA/540/2-88/004, September 1988.

3 Classification of whether or not a chemical is a dense nonaqueous phase liquid (DNAPL) in pure form is from Cohen and Mercer, 1993 (see References).

4 In pure form mercury is also a DNAPL.

cs These organic contaminants are chlorinated solvents. A total of 12 are listed.

pf These organic contaminants are constituents of petroleum fuels. A total of four are listed.

Appendix A3: Examples of In-Situ Treatment Technologies[1]

I. Enhanced Recovery Methods	Treatment Agents (and process type)	Agent Delivery [illegible]
Recirculation/flooding:		
- Water flooding (physical)	- Water - Heated water	- Injection wells - Injection wells
- Steam flooding (physical)	- Steam	- Injection wells
- Chemical flooding[2] (chemical)	- Surfactants - Solvents - Redox agents	- Injection wells - Injection wells - Injection wells
- Nutrient flooding[2] (biological)	- Nitrate - Other	- Injection wells
Thermal enhanced recovery:		
- Radio frequency	- Heat	- Electrodes [illegible]
- Electrical resistance (AC or DC)	- Heat	- Electrodes [illegible]
Enhancement of secondary permeability:		
- Induced fracturing with water or or air pressure (physical)	Not applicable	Not applicable
Other methods:		
- Electromigration (electrical)	- Electric current	- Electrodes [illegible]

NOTES:

1 List of technologies and technology status is from EPA, 1993h (see References section of [illegible]

2 Chemicals or nutrients for micro-organisms, respectively, are added to reinjection water

Appendix A3: Examples of In-Situ Treatment Technologies (continued)[1]

II. In-situ Treatment Processes	Treatment Agents	Agent Delivery Methods
Physical/chemical treatment:		
- Volatilization and oxygen enhancement by **air sparging**	- Air	- Injection wells - **Permeable walls/gates[3]**
- Reductive dehalogenation by metal catalysts (abiotic)	- Iron filings - Other agents	- **Permeable walls/gates[3]**
Biological treatment:		
- Oxygen enhancement of aerobic organisms (also includes air sparging, above)	- Hydrogen peroxide - Oxygen/surfactant (microbubbles)	- Injection wells[4] - Injection wells[4]
- Nutrient enhancement of aerobic organisms	- Nitrate - Other	- Injection wells[3]
- Nutrient enhancement of anaerobic organisms to produce enzymes that degrade contaminants (cometabolism)	- Methane - Other	- Injection wells
- Sequential anaerobic-aerobic treatment	- Methane and/or Oxygen	- Injection wells

NOTES.

[3] In permeable treatment walls/gates, treatment agents are added with trench backfill materials or are injected via perforated pipes placed in the backfill. These walls are placed in the subsurface across the natural flow path of the contaminant plume. They can be combined with impermeable flow barriers in a "funnel and gate" arrangement, in which flow is directed through the treatment walls/gates.

[4] Use of permeable treatment walls/gates to deliver treatment agents for these methods may also be feasible

Appendix A4: Definition and Discussion of Pulsed Pumping

Pulsed Pumping

In pulsed pumping, some or all extraction pumps are turned off and then back on for specified periods of time (e.g., one or more monitoring periods). The on and off cycles can be continued or the extraction and treatment remedy can be returned to continuous pumping. Although not widely used in remedies to date, this method may be effective in **enhancing the recovery of contaminants from the aquifer**. Pulsed pumping can recover contaminants located in the following portions of the aquifer that are relatively unaffected during pumping:

- Upper portions of the aquifer that have been dewatered by pumping, and
- Zones with minimal ground-water flow during pumping (flow stagnation zones).

Pulsed pumping **may** also enhance contaminant recovery for aqueous phase contaminants that are sorbed to the aquifer matrix. Therefore, pulsed pumping can be initiated as a **post-construction refinement** of an extraction and treatment remedy (see Section 2.4), when an evaluation of remedy performance indicates that this technique may increase the recovery of contaminants from the aquifer.

Pulsed pumping can also be used as a method of evaluating the effectiveness of an extraction and treatment remedy and/or the effectiveness of source control actions. For example, if contaminant levels increase substantially when pumping is stopped, it is an indication that contaminants continue to be derived from source materials, and that additional remedial measures (e.g., source control/removal) may be necessary. These source materials could include aqueous contaminants sorbed to aquifer solids in finer-grained aquifer layers, NAPLs (refer to Appendix A1), contaminated soils, or other sources.

Pulsed pumping should generally **not be initiated** until after sufficient monitoring data has been obtained from continuous pumping to establish a statistically valid performance trend. Also, the influence of pulsed pumping on plume containment should be considered; and extraction wells used primarily for containment (i.e, at plume leading edge) should generally not be pulsed.

APPENDIX B

ROD Language Examples For Selected Remedy

Appendix B1: Phased Implementation of Ground-Water Remedy (continued)

The selected remedy will include ground-water extraction for an estimated period of 20 years, during which the system's performance will be carefully monitored, in accordance with the monitoring plan defined in Section ___ of the ROD, and adjusted as warranted by the performance data collected during operation. ***Refinement*** *of the extraction system may be required, if EPA determines that such measures will be necessary in order to restore Aquifer C in a reasonable timeframe, or to significantly reduce the timeframe or long-term cost of attaining this objective.* ***Refinement of the extraction system may include any or all of the following:***

1) *Adjusting the rate of extraction from some or all wells;*

2) *Discontinuing pumping at individual wells where cleanup goals have been attained;*

3) *Pulsed pumping of some or all extraction wells to eliminate flow stagnation areas, allow sorbed contaminants to partition into ground water, or otherwise facilitate recovery of contaminants from the aquifer; and*

4) *Installing up to two additional ground-water extraction wells to facilitate or accelerate cleanup of the contaminant plume.*[1]

It is possible that performance evaluations of the ground-water extraction system - after completion of phase one, during implementation or operation of phase two, or after subsequent refinement measures - will indicate that restoration of Aquifer C is technically impracticable from an engineering perspective. ***If such a determination is made by EPA, the ultimate remediation goal and/or the selected remedy may be reevaluated.***[2]

NOTES:

1. Although not required in a ROD, the **estimated number of wells** is included in this example for the following reasons, to:

   - Provide a **basis for estimating the** cost of the selected remedy, including upper and lower costs for phase one, phase two and the potential refinement measures;

   - Provide some **specificity regarding how the extraction component of the remedy will be used in the overall remediation strategy**, because changes in the extraction system directly influence the time period required to attain the remedial objectives for this site; and to

   - Provide some **bounds for the scope, performance and cost of the selected remedy**, which will assist in determining whether future, post-ROD remedy modifications require an Explanation of Significant Differences (see Section 2.4 of this guidance).

2. Reevaluation of the ultimate remediation goal and/or the selected remedy would generally require an ESD or ROD amendment.

Appendix B1: Phased Implementation of Ground-Water Remedy

Site Conditions:

At **hypothetical Site 1** (an LNAPL site) surficial soils and the underlying ground water in Aquifer C are contaminated with volatile organic compounds (VOCs). At this site, Aquifer C is currently used as a source of drinking water, with several wells located on-site and in the estimated path of the contaminant plume.

Early actions were used for exposure prevention and source control. Under Superfund **removal authority**, an alternate water supply was provided to several residences, and leaking drums and heavily contaminated soils were excavated and taken off-site for disposal. A soil vapor extraction system was installed as an **interim remedial action**. No further source control actions are planned. DNAPLs are not likely to be present in the subsurface because most of the contaminants are LNAPLs rather than DNAPLs in pure form. The selected ground-water remedy relies on extraction and treatment for preventing further migration of the contaminant plume and for restoration of Aquifer C. **The selected remedy will be implemented in two construction phases.**

ROD Language for Extraction Component of Remedy:

The following, or similar language, should appear in the **Selected Remedy** section of the ROD:

> *The **ultimate goal** for the ground-water portion of this remedial action is to restore Aquifer C to its beneficial uses. At this site, Aquifer C is currently used as a source of drinking water. Based on information obtained during the remedial investigation and on a careful analysis of all remedial alternatives, EPA and the State of ___ believe that the selected remedy will achieve this goal.*
>
> *The extraction portion of the ground-water remedy will be implemented in two phases. In phase one, a sufficient number of extraction wells will be installed with the **objective of minimizing further migration of the contaminant plume**. It is currently estimated that two to four extraction wells will be required for phase one.[1] After construction of phase one is completed, the extraction system will be carefully monitored on a regular basis and its performance evaluated. **Operation and monitoring of phase one for a period of up to one year may be needed to provide sufficient information to complete the design of phase two.***
>
> *In phase two, additional extraction wells will be installed with the **objective of restoring Aquifer C for use as a source of drinking water**, in addition to maintaining the remedial objectives for phase one. Restoration is defined as attainment of required cleanup levels in the aquifer, over the entire contaminant plume. Cleanup levels for each ground-water contaminant of concern are specified in Table ___ of the ROD. Current estimates indicate that an additional two to four extraction wells may be required to attain these cleanup levels within a timeframe of approximately 20 years.[1] However, **monitoring and evaluation of the performance of phase one will be used to determine the actual number and placement of wells for phase two**.*

Appendix B2: Phased Implementation of Extraction Component of Remedy at a DNAPL Site

<u>**Site Conditions**</u>:

At **hypothetical Site 2** (a DNAPL site), ground water in Aquifer A is contaminated with volatile and semivolatile organic contaminants (no metals as contaminants of concern). DNAPLs have also been observed in this aquifer. At this site, Aquifer A is not currently used as source of drinking water, but several wells are located off-site in the estimated path of the contaminant plume.

The selected remedy includes extraction and treatment for hydraulic containment of the likely **DNAPL-zone** (see Appendix A1 of this guidance) and for restoration of the aquifer outside the DNAPL-zone. Reinjection of a portion of the treated ground water will be used to enhance recovery of contaminants from the aquifer. It has been determined that aquifer restoration within the DNAPL-zone is technically impracticable from an engineering perspective, as explained in the <u>**Statutory Determinations**</u> section of the ROD. **The remedy will be implemented in two construction phases.**

<u>**ROD Language for Extraction Component of Remedy**</u>:

The following, or similar language, should appear in the <u>**Selected Remedy**</u> section of the ROD:

> *The **ultimate goal** for the ground-water portion of this remedial action is to restore the maximum areal extent of Aquifer A to its beneficial uses. At this site Aquifer A is potentially useable as a source of drinking water and is currently used off-site for this purpose. Based on information obtained during the remedial investigation and on a careful analysis of all remedial alternatives, EPA believes that the selected remedy will achieve this goal.*
>
> *The **extraction portion of the ground-water remedy** will be implemented in two phases. **In phase one**, a sufficient number of extraction wells will be installed to achieve **two remedial objectives for Aquifer A**: 1) minimizing further migration of contaminants from suspected subsurface DNAPL areas to the surrounding ground water; and 2) minimizing further migration of the leading edge of the contaminant plume. It is currently estimated that three to five extraction wells will be required for phase one.[1] After construction of phase one is completed, the extraction system will be carefully monitored on a regular basis and its performance evaluated. This evaluation may provide further information concerning the extent of the DNAPL-zone. **Operation and monitoring of phase one for a period of up to two years may be needed to provide sufficient information to complete the design of phase two.***
>
> *In **phase two**, additional extraction wells will be installed with the objective of **restoring the maximum areal extent of Aquifer A** for use as a source of drinking water, in addition to maintaining phase one objectives. Reinjection wells and related pumping equipment for flushing a portion of the treated ground water through the aquifer (water flooding) will also be installed in order to enhance the recovery of contaminants. Restoration is defined as attainment of required cleanup levels in the aquifer, over the portion of the contaminant plume outside the DNAPL-zone. Cleanup levels for each ground-water contaminant of concern are specified in Table __ ; although cleanup level ARARs within the DNAPL-zone have been waived by EPA due technical impracticability from an engineering perspective, as discussed in Section __ of the ROD. Current estimates indicate that these cleanup levels can be attained in the portion of Aquifer A outside the DNAPL-zone within a timeframe of approximately 25 years.*

Appendix B2: Phased Implementation of Extraction Component of Remedy at a DNAPL Site (continued)

Current estimates also indicate that an additional two to six extraction wells and two to four reinjection wells may be required for phase two.[1] ***However, monitoring and evaluation of the performance of phase one will be used to determine the actual number and placement of wells for phase two.***

The selected remedy will include ground-water extraction for an ***estimated period of 25 years,*** *during which the system's performance will be carefully monitored, in accordance with the monitoring plan defined in Section ___ of the ROD, and adjusted as warranted by the performance data collected during operation.* ***Refinement*** *of the extraction system may be required, if EPA determines that such measures will be necessary in order to restore the maximum areal extent of Aquifer A in a reasonable timeframe, or to significantly reduce the timeframe or long-term cost of attaining this objective.* ***Refinement of the extraction system may include any or all of the following:***

1) *Adjusting the rate of extraction from some or all wells;*

2) *Discontinuing pumping at individual wells where cleanup goals have been attained;*

3) *Pulsed pumping of some or all extraction wells to eliminate flow stagnation areas, allow sorbed contaminants to partition into ground water, or otherwise facilitate recovery of contaminants from the aquifer;*

4) *Installing up to two additional ground-water extraction wells to facilitate or accelerate cleanup of the contaminant plume; and*[1]

5) *Installing up to two additional reinjection wells.*[1]

It is possible that performance evaluations of the ground-water extraction system - after completion of phase one, during implementation or operation of phase two, or after subsequent refinement measures - will indicate that restoration of portions or all of Aquifer A is technically impracticable from an engineering perspective. ***If such a determination is made by EPA, the ultimate remediation goal and/or the selected remedy may be reevaluated.***[2]

NOTES:

1. The reasons for including the **estimated number of wells** in this example are discussed in the Notes section of the previous example, Appendix B2.

2. Reevaluation of the ultimate remediation goal and/or the selected remedy would generally require an ESD or ROD amendment.

Appendix B3: Deferring Selection of Treatment Components to Remedial Design

<u>Site Conditions</u>:

Hypothetical Site 2 is the same site used in the previous example, Appendix B2. Most of the treated ground water will be discharged to the nearby Muddy River, although a portion (20 to 30 percent) will be reinjected to Aquifer A to enhance contaminant recovery. Contaminant-specific and other water quality requirements for discharge to the Muddy River were specified by the state and are listed in Table ___ of the ROD. Other specifications for the treatment system are also listed in the ROD, which include filtering of suspended mineral solids to minimize clogging of reinjection wells; and treatment of vapor phase organic contaminants from air stripping or other processes, as requested by the local community.

<u>ROD Language for Treatment Component of Remedy</u>:

> *The* ***ex-situ treatment component of the ground-water*** *remedy will utilize presumptive technologies identified in Directive 9283.1-12 from EPA's Office of Solid Waste and Emergency Response (OSWER), included as Attachment __ of the ROD. Since contaminants of concern include volatile and semivolatile organic compounds,* ***one or more of the presumptive technologies*** *- air stripping, granular activated carbon (GAC), chemical/UV oxidation and aerobic biological reactors - will be used for treating aqueous contaminants in the extracted ground water. Other technologies will also be needed in the treatment system for removal of suspended mineral solids and treatment of vapor phase contaminants.* ***The actual technologies and sequence of technologies used for the treatment system will be determined during remedial design.*** *Final selection of these technologies will be based on additional site information to be collected during the remedial design. (See Section 3.4 and Appendix C3 of OSWER Directive 9283.1-12 for a discussion of site information needed for selection and design of the ex-situ treatment system.) Based on this additional information and sound engineering practice the treatment system shall be designed to:*
>
> - *Attain the chemical-specific discharge requirements and other performance criteria specified in Table __ and Section __ of the ROD; and*
> - *Treat, or be easily modified to treat, the expected flow increase from phase one to phase two of the extraction system.*
>
> *Other design factors shall include:*
>
> - *Maximizing long-term effectiveness,*
> - *Maximizing long-term reliability (i.e., minimize the likelihood of process upsets), and*
> - *Minimizing long-term operating costs.*
>
> *Additional information concerning presumptive technologies for the ex-situ treatment component of the remedy is provided in OSWER Directive 9283.1-12. Descriptions of each of the presumptive technologies are presented in Appendices D1 through D8, and advantages and limitations of each of these technologies are listed in Appendix C4 of this directive.*

Appendix B3: Deferring Selection of Treatment Components to Remedial Design (continued)

*For the purpose of estimating the approximate cost of the **treatment component** of the selected remedy, the following treatment sequence is assumed for **aqueous contaminants**: flow equalization tanks, a gravity oil-water separator, an air stripper, followed by GAC units. GAC will also be used to treat **vapor phase contaminants** from the air stripper. The GAC units will be thermally reactivated at an off-site facility. Separated DNAPL compounds will be recycled if possible, but since the actual composition of the recovered liquids is unknown, costs for incineration at an off-site facility were used for the cost estimate.*

Appendix B4: Suggested ROD Language from 1990 OSWER Directive

Recommended language for the Selected Remedy section of the ROD was given in OSWER Directive 9283.1-03, entitled "Suggested ROD Language for Various Ground-Water Remediation Options," dated October 10, 1990. For the RODs in which the final remedy without a contingency is selected, this Directive recommended that "the following type of language should appear in the **Selected Remedy** section of the ROD:"

> *The goal of this remedial action is to restore ground water to its beneficial use, which is, at this site, (specify whether this is a potential or actual drinking water source, or is used for non-domestic purposes). Based on information obtained during the remedial investigation and on a careful analysis of all remedial alternatives, EPA < (optional) and the State/Commonwealth of _____ > believe that the selected remedy will achieve this goal. It may become apparent, during implementation or operation of the ground-water extraction system and its modifications, that contaminant levels have ceased to decline and are remaining constant at levels higher than the remediation goal over some portion of the contaminated plume. In such a case, the system performance standards and/or the remedy may be reevaluated.*
>
> *The selected remedy will include ground-water extraction for an estimated period of _____ years, during which the system's performance will be carefully monitored on a regular basis and adjusted as warranted by the performance data collected during operation. Modifications may include any or all of the following:*
>
> *a) at individual wells where cleanup goals have been attained, pumping may be discontinued;*
>
> *b) alternating pumping at wells to eliminate stagnation points;*
>
> *c) pulse pumping to allow aquifer equilibration and to allow adsorbed contaminants to partition into ground water; and*
>
> *d) installation of additional extraction wells to facilitate or accelerate cleanup of the contaminant plume.*
>
> *To ensure that cleanup goals continue to be maintained, the aquifer will be monitored at those wells where pumping has ceased on an occurrence of every _____ years following discontinuation of ground-water extraction.*

Appendix C4: Advantages and Limitations of Presumptive Treatment Technologies

Technology	Advantages	Limitations
Treatment Technologies for the Removal of Organic Contaminants		
Air Stripping	• Successfully used in hundreds of groundwater applications • Low operating cost relative to other technologies (e.g., energy usage is relatively low). • Operationally simple system requiring a minimum of operator assistance. • Treatability studies often not required for selection or design, but are recommended. • Trained contractors available to implement the technology.	• Contaminants transferred to air, and treatment of air emissions may be required. • Pretreatment for metals removal and pH control may be needed to reduce fouling and corrosion. • Post-treatment (polishing) may be required. • Large surges in influent concentrations can reduce removal efficiency because the efficiency for an individual compound is fixed regardless of influent concentrations. • Air stripping is not as effective for compounds with low Henry's law constants or high solubilities.[b,c] • Cold weather can reduce efficiency.
Granular Activated Carbon	• Successfully used for contaminated ground water at many Superfund and underground storage tank sites. • Operationally simple system requiring a minimum of operator assistance. • Regularly used as a <u>polishing</u> step following other treatment technologies. • Treatability studies generally not required, but are recommended (information is available from carbon vendors). • Trained contractors available to implement the technology. • Generally a cost-effective alternative as single- step treatment for flows less than about 3 gpm.[d]	• Activated carbon is generally too costly for use as a single-step treatment if ground-water chemistry requires high carbon usage rates. • Contaminants are not destroyed but are transferred to another media (i.e., spent carbon must be regenerated or disposed of properly). • Pretreatment for suspended solids removal is often required. • Pretreatment for metals removal and pH control may be needed to reduce fouling and corrosion. • Organic compounds that have low molecular weight and high polarity are not recommended for activated carbon (e.g., acetone). • Naturally occurring organic compounds may exhaust carbon bed rapidly and may interfere with the adsorption of targeted chemicals.

Appendix C4: Advantages and Limitations of Presumptive Treatment Technologies (continued)

Technology	Advantages	Limitations
Chemical/ UV Oxidation	• Where oxidation is complete, organic contaminants are destroyed and not transferred to other media; minimal residuals generated. • Effective on a wide variety of volatile and semivolatile organics, including chlorinated organics, as well as cyanide and some metals. • Operating costs can be competitive with air stripping and activated carbon.	• Incomplete oxidation will leave original contaminants and possibly toxic oxidation products, activated carbon polishing may be required. • Capital costs may preclude small-scale applications, especially for ozone systems. • Metals may precipitate during oxidation, requiring filtration post-treatment and residuals disposal. • UV light sources are subject to fouling and scaling from solids, iron compounds, carbonates, etc. Pretreatment may be required to remove these substances. • Process must be closely monitored to ensure contaminant destruction and to prevent safety hazards. • Peroxide and other chemical oxidants must be properly stored and handled. • Site-specific treatability studies are necessary (process may require large quantities of oxidizer to destroy target compound(s) if reactive nontarget compounds are present).
Aerobic Biological Reactors	• Organic contaminants degraded, often with minimal cross-media environmental impacts. • Proven effective for many organic compounds. • Some systems (e.g., trickling filters and rotating biological contactors) have minimal energy requirements and generally low capital and operating costs. • Can be designed to require a minimum of operator attention. • Relatively simple, readily available equipment. • Trained contractors available to implement the technology.	• A residual organic sludge is generated that must be disposed of properly. • Some compounds are difficult or impossible to degrade (recalcitrant) or slow to degrade • Difficulties acclimating microorganisms to contaminants are possible; requires longer startup time than other technologies to achieve effective steady-state performance • Volatile organics may require air emission controls or pretreatment to remove them. • Variations in flow or concentration may require significant operator attention to prevent microorganisms from being killed. • Cold weather can cause operational difficulties. • Treatability studies are needed for selection and design. • Pretreatment may be needed to remove contaminants toxic to the microorganisms, such as heavy metals. • Low organic loading and the potential for supplementary nutrients and food sources must be considered.

ATTACHMENT 3

ADMINISTRATIVE RECORD INDEX

U.S. ENVIRONMENTAL PROTECTION AGENCY
REMEDIAL ACTION

ADMINISTRATIVE RECORD
FOR
SAUGET AREA 2 GROUNDWATER INTERIM ACTION
SAUGET AND CAHOKIA, ILLINOIS

ORIGINAL
JUNE 20, 2002

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
1	06/16/83	Ecology and Environment, Inc.	U.S. EPA	Preliminary Assessment for the Sauget/Sauget and Company Landfill Site	20
2	05/00/88	Ecology and Environment, Inc.	Illinois EPA	Final Report: Expanded Site Inspection for the Dead Creek Sediment Sites at Cahokia/Sauget, IL: Volume 1 of 2 (Text, Figures and Tables)	476
3	05/00/88	Ecology and Environment, Inc.	Illinois EPA	Final Report: Expanded Site Inspection for the Dead Creek Sediment Sites at Cahokia/Sauget, IL: Volume 2 of 2 (Appendices A-F)	554
4	12/10/98	Federal Register	Public	National Recommended Water Quality Critera: Notice; Republication (FR Part IV EPA: Vol. 63, No. 237)	12
5	06/23/00	Carney, W., U.S. EPA	Addressees	Letter re: Special Notice of Liability for the Sauget Area 2 Site	82
6	08/01/00	Solutia, Inc.	U.S. EPA	Description of Current Conditions for the W.G. Krummrich Plant, Sauget, Illinois: Volume 1 (Text, Tables, Figures, Attachments 1-4 and Appendices 1-15 **[DRAFT]**	156
7	08/25/00	Tetra Tech EM, Inc.	U.S. EPA	Community Involvement Plan for Sauget Areas 1 and 2 Superfund Sites w/ Cover Letter	34
8	09/01/00	Solutia, Inc.	U.S. EPA	Description of Current Conditions for the W G. Krummrich Plant, Sauget, Illinois Volume 2 (Appendices 16-23) **[DRAFT]**	687

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
9	09/[illegible]1/00	Solutia, Inc.	U.S. EPA	Description of Current Conditions for the W.G. Krummrich Plant, Sauget, Illinois Volume 3(Appendices 24-25) **[DRAFT]**	[illegible]
10	10/03/00	Illinois EPA	File	Illinois EPA HazMat Incident Report re: a Crude Chlorobenzene Spill at the Solutia, Inc. Facility w/Attachments	6
11	10/10/00	Mosher, B., Illinois EPA	Bardo, K., U.S. EPA	FAX Transmission re: Listing of Derived Water Quality Criteria as Published in the Illinois Register	11
12	10/13/00	Bardo, K., U.S. EPA	Mosher, B., Illinois EPA	FAX Transmission re: Water Quality Criteria Standards	2
13	11/24/00	U.S. EPA	Respondents	Administrative Order by Consent re: the Sauget Area 2 Site	59
14	01/22/01	Graczyk, L., Tetra Tech EM, Inc.	Freeman, B., U.S. EPA	Letter: Data Validation Report for Samples Collected October 24-November 3, 2000 at the Solutia, Inc. Facility	58
15	01/26/01	Search, G., Illinois EPA	Illinois EPA	Memorandum re: January 25, 2001 Meeting to Discuss Monochlorobenzene Release at the Solutia, Inc. Facility w/Attachments	33
16	02/09/01	Hamper, G., U.S. EPA	Hiller, R., Solutia, Inc.	Letter re: Water Quality Criteria at Solutia, Inc. w/Attachments	28
17	05/15/01	Graczyk, L., Tetra Tech EM, Inc.	Barr, J., Dyna Corp.	Chain of Custody Forms and Data Summary Forms for Solutia, Inc. w/Cover Letter	
18	06/01/01	Menzie-Cura & Associates, Inc	Solutia, Inc.	Report: Ecological Risk Assessment for the W.G. Krummrich Plant in Sauget, IL **(REV. 1: INTERNAL REVIEW DRAFT)**	992
19	08/09/01	Bardo, K., U.S. EPA	Hiller, R., Solutia, Inc	Letter re: U.S. EPA's Comments on Solutia, Inc.'s June 21, 2001 Ecological Risk Assessment w/ Attachment	15

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
20	11/14/01	Ripordy, M., U.S. EPA	Smith, S., Solutia, Inc.	Letter re: Notification of Additional Work for the Focused Feasibility Study for Groundwater Contamination at Site R, Sauget Area 2 w/Attachment	11
21	03/31/02	Solutia, Inc.	U.S. EPA	Focused Feasibility Study for Sauget Area 2 Sites O, Q, R and S (Volume 1: Text, Tables and Figures)	433
22	03/31/02	Solutia, Inc.	U.S. EPA	Focused Feasibility Study for Sauget Area 2 Sites O, Q, R and S (Volume 2: Design Basis and Design	905

UPDATE #1
JUNE 27, 2002

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
1	06/00/02	U.S. EPA	Public	Fact Sheet: U.S. EPA Issues Proposed Plan for Interim Ground-water Cleanup At Sauget Area 2 Site	8

UPDATE #2
JULY 24, 2002

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
1	06/24/02	Pohlman Reporting Company	U.S. EPA	Transcript of the June 24, 2002 Public Meeting re: the Sauget Area 2 Superfund Site	32

UPDATE #3
SEPTEMBER 23, 2002

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
1	09/00/01	Roy F. Weston, Inc.	U.S. EPA	Site Assessment Report for the Clayton Chemical Site in Sauget, IL	
2	06/00/02	U.S. EPA	Public	Fact Sheet: U.S. EPA Issues Proposed Plan for Interim Ground-Water Cleanup at Sauget Area 2 Site	8
3	06/17/02	Belleville News-Democrat	Public	U.S. EPA Public Notice: Announcement of a Public Meeting and Public Comment Period for the Proposed Plan for the Sauget Area 2 Site	1

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
4	07/17/02	Andria, K., American Bottom Conservancy	Hill, S., U.S. EPA	E-Mail Transmission re: Request for 30 Day Extension to the Public Comment Period on the Proposed Plan for the Sauget Area 2 Site	[illegible]
5	07/17/02	Andria, K., American Bottom Conservancy	Hill, S., U.S. EPA	E-Mail Transmission re: Public Comment on the Proposed Plan for the Sauget Area 2 Site	1
6	07/23/02	U.S. EPA	Public	Postcard: U.S. EPA Announcement of a Public Comment Extension for the Proposed Plan for the Sauget Area 2 Site	2
7	00/00/00	U.S. EPA	Public	Record of Decision for the Sauget Area 2 Ground-water Interim Action **(PENDING)**	

ATTACHMENT 4

STATEMENT OF WORK FOR
THE REMEDIAL DESIGN AND REMEDIAL ACTION
AT THE
SAUGET AREA 2 SITE
ST. CLAIR COUNTY, ILLINOIS

STATEMENT OF WORK FOR
THE REMEDIAL DESIGN AND REMEDIAL ACTION
AT THE
SAUGET AREA 2 SITE
ST. CLAIR COUNTY, ILLINOIS

I. PURPOSE

The purpose of this Statement of Work (SOW) is to set forth requirements for implementation of the remedial action set forth in the Record of Decision (ROD), which was signed by the Regional Administrator of U.S. EPA Region 5 on September 30, 2002, for the Sauget Area 2 Site (Site) Groundwater Operable Unit (OU-2). The Settling Defendants shall follow the ROD, the SOW, the approved Remedial Design, Remedial Action (RD/RA) Work Plan, U.S. EPA Superfund Remedial Design and Remedial Action Guidance and any additional guidance provided by U.S. EPA in submitting deliverables for designing and implementing the remedial action for OU-2.

II. DESCRIPTION OF THE REMEDIAL ACTION/PERFORMANCE STANDARDS

Settling Defendants shall design and implement the Remedial Action to meet the performance standards and specifications set forth in the ROD and this SOW. Performance standards shall include cleanup standards, standards of control, quality criteria and other substantive requirements, criteria or limitations including all Applicable or Relevant and Appropriate Requirements (ARARs) set forth in the ROD, SOW and/or Unilateral Administrative Order (UAO) and further identified during the RD when the groundwater treatment option is determined.

1. Site Security

The Settling Defendants shall regularly inspect, maintain, properly repair or replace the fence and any portion thereof at the Site during the Remedial Design/Remedial Action and Operation and Maintenance (O&M), to prevent access and vandalism to the Site. Warning signs on the fence shall also be maintained.

2. Restrictive Covenants/Deed Restrictions

Institutional controls will be utilized to limit fishing in the plume release area by limiting site access, posting warning signs, and implementing a public education program.

3. Groundwater Containment System

A. Barrier Wall

The Settling Defendants shall design, construct and maintain a 3,500 foot long, "U"-shaped, fully penetrating, jet grout barrier wall between the downgradient boundary of Sauget Area 2 Site R and the Mississippi River to abate the release of impacted groundwater. The purpose of the barrier wall is to minimize the volume of groundwater that has to be extracted to ensure equal heads on both sides of the wall. It will extend along the entire 2,000 foot north/south length of Site R with the arms of the "U" extending approximately 750 feet to the east (upgradient), past the eastern boundary of Site R and terminating before the USACE floodwall. The barrier wall will be taken to the top of the bedrock surface which is expected to be in the range of 120 to 140 feet deep. The injection holes will be drilled a few feet into the rock to ensure that the injection ports are at the same elevation as the top of the rock. The geometry and installation methods for the wall will be optimized during the remedial design. The jet grout wall will be designed to produce a continuous barrier with minimal gaps. Minor discontinuities may occur because of very localized geologic variations. These discontinuities, if they exist, are expected to be very minor and will not materially affect the performance of the system. Larger discontinuities will be identified by the QA/QC program and addressed.

Quality control measures will include the construction of test cells prior to wall construction and evaluation of the integrity by performing a pump drawdown test within the cell, pre-drilling the grout injection holes and gauging each hole with an inclinometer to ensure verticality, and coring the completed panels at regular intervals to check for strength and soil-grout consistency.

B. Groundwater Extraction

The Settling Defendants shall design, install, operate and maintain a groundwater extraction system to abate groundwater discharging to the wall. A system of 3 partially penetrating groundwater recovery wells pumping from 303 to 724 gpm is thought to be necessary to abate groundwater discharging to the wall. However, final number of wells and placement and extraction rates are subject to change by USEPA. Modeling indicates that groundwater is released to the Mississippi River for high, average and low river stage conditions at 303, 535 and 724 gpm, respectively (Volume II - Design Basis and Design). The wells will be installed inside the "U"-shaped barrier wall. A river stage gage will be installed in the Mississippi River downgradient of Site R. Water level information from the gage will be sent by telemetry to the pump controller that will adjust the variable frequency drives to produce the required pumping rates to control the groundwater discharging to the barrier wall (Volume II - Design Basis and Design).

Operation of the extraction system used to contain the contaminated groundwater within the barrier wall may only be terminated at the written direction of U.S. EPA. However, the

Settling Defendants may petition U.S. EPA to modify the extraction system based on such factors as attainment of groundwater standards outside the barrier wall or performance data from the system that indicates that performance standards can be met under other operating conditions. The Settling Defendants shall monitor the system's performance on a regular basis. U.S. EPA may require adjustments to the system as U.S. EPA deems warranted by the performance data collected during its operation. Examples of adjustments which may be required by U.S. EPA are additional groundwater extraction wells and/or increased pumping rates.

C. Groundwater Treatment

The Settling Defendants shall pump the extracted groundwater to a groundwater treatment system for removal of chemicals. Selection of the actual treatment technologies and the location of the treatment system will be determined during the remedial design. The treatment component of the groundwater alternative will utilize presumptive technologies identified in EPA's groundwater presumptive strategy, "Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Site", October 1996, Office of Solid Waste and Emergency Response (OSWER) Directive 9283.1-12. Since contaminants of concern include volatile and semivolatile organic compounds, one or more of the presumptive technologies - air stripping, granular activated carbon (GAC), chemical/UV oxidation and aerobic biological reactors - will be used for treating aqueous contaminants in the extracted ground water. Other technologies may also be needed in the treatment system for removal of suspended mineral solids and treatment of vapor phase contaminants. The actual technologies and sequence of technologies used for the treatment system will be determined during the remedial design. Final selection of these technologies will be based on additional site information to be collected during the remedial design. Based on this information and sound engineering practice, the treatment system shall be designed to attain the chemical-specific discharge or pretreatment requirements and other performance criteria in compliance with ARARs. Other design factors shall include maximizing long-term effectiveness, maximizing long-term reliability (i.e., minimizing the likelihood of process upsets), and minimizing long-term operating costs. Treated groundwater will ultimately be discharged to the Mississippi River. Any discharge to the Mississippi River will be in compliance with all ARARs.

4. Installation and Operation of Monitoring Program for Remedial Action

Settling Defendants shall implement monitoring program(s) to evaluate and ensure that the construction and implementation of the Remedial Action comply with approved plans and design documents and performance standards. Settling Defendants shall submit monitoring programs as part of the Remedial Design Work Plan, which shall address the specific components of the remedial action listed below. Each sample shall be analyzed for a list of parameters approved by U.S. EPA during design.

A. Groundwater Quality Monitoring

The Settling Defendants shall implement a groundwater quality monitoring program as identified in the ROD and the RD Work Plan. Groundwater quality samples will be collected downgradient of the physical barrier to determine mass loading to the Mississippi River resulting from any contaminants migrating through, past or beneath the barrier wall. The Settling Defendants shall collect groundwater quality samples from four monitoring well clusters identified in the ROD. Samples will be analyzed for VOCs, SVOCs, Herbicides, Pesticides and Metals. TOC and TDS will also be determined for each sample. Each well cluster will consist of monitoring wells screened in the Shallow, Middle and Deep Hydrogeologic Units. A total of twelve monitoring wells will be installed. Settling Defendants shall collect groundwater quality samples quarterly until the final groundwater remedy and associated groundwater monitoring program for the Sauget Area 2 Site is in place. Mass loading for each hydrogeologic unit will be calculated using average TOC and TDS concentration in the unit. Total mass loading to the Mississippi River will be determined by summing the mass loads for the SHU, MHU and DHU. Total mass loading will be plotted over time to track changes in the amount of mass discharging to the Mississippi River.

If additional information indicates that the groundwater monitoring program is inadequate, U.S. EPA may require additional groundwater monitoring wells and laboratory analysis of additional parameters.

B. Groundwater Level Monitoring

Settling Defendants shall implement a groundwater level monitoring program to ensure acceptable performance of the physical barrier. Soil samples from the borings completed for the purpose of installing water-level piezometers will be screened for the presence of NAPL. In addition, existing wells downgradient of Sauget Area 2 Site R will be measured for accumulation of NAPL.

Settling Defendants shall monitor groundwater levels at the physical barrier to determine if gradient control is achieved. Gradient control will be determined by:

- Comparing the water-level elevations in pairs of fully penetrating water-level piezometers installed at the northwest corner of the barrier wall, southwest corner, halfway between the south pumping well and the center pumping well, and halfway between the north pumping well and the center pumping well as specified in the ROD. One piezometer of each pair will be installed inside the barrier wall and one will be installed outside it. Pumping rates will be adjusted so that the water-level elevation in the inside piezometer is the same as the water-level elevation in the outside piezometer. This will ensure that groundwater discharging to the physical barrier is controlled. Electronic water-level recorders will be installed in each piezometer and telemetry will be used to send the water-level data to the pump controller. Groundwater elevations inside and outside the barrier wall will be compared by the pump controller and pumping rates will be adjusted to maintain the same groundwater level elevation inside the barrier wall as measured outside the wall.

- Groundwater levels will be measured manually on a quarterly basis in existing wells B-21B, B-22A, B-24C, B-25A, B-25B, B-26A, B-26B, B-28A, B-28B and B-29B to supplement gradient control information from the water-level piezometers.

C. Sediment and Surface Water Monitoring

Settling Defendants shall collect sediment and surface water samples in the plume discharge area to determine the effect of any contaminants migrating through, past or beneath the barrier wall and discharging to the Mississippi River. Impact will be determined by comparing constituent concentrations to site-specific, toxicity-based, protective concentrations derived from existing sediment and surface water chemistry and toxicity data. An Apparent Effects Threshold approach will be used to derive site-specific, protective constituent concentrations for sediments and a Toxic Units approach will be used to derive site-specific, protective constituent concentrations for surface water.

Surface water and sediment samples will be collected at Sediment Sampling Stations - 2, 3, 4, 5 and 9, where toxicity was observed in October/November 2000, and analyzed for VOCs, SVOCs, Herbicides, Pesticides and Metals. Constituent concentrations will be plotted as a function of time and compared to the site-specific, toxicity-based, protective concentrations to determine progress toward achieving these targets.

Settling Defendants shall conduct sediment and surface water sampling twice a year, once during the summer low flow period and once during the winter low flow period, when groundwater discharge to the Mississippi River is high.

III. SCOPE OF REMEDIAL DESIGN AND REMEDIAL ACTION

The Remedial Design/Remedial Action shall consist of five tasks. All plans are subject to USEPA approval in consultation with the Illinois EPA.

Task 1: RD/RA Work Plan

Task 2: Remedial Design Phases

A. Prefinal Design/Final Design

Task 3: Remedial Action/Construction

A. Preconstruction Meeting
B. Prefinal Inspection
C. Final Inspection
D. Reports

1. Final Construction Report
2. Completion of Remedial Action Report
3. Completion of Work Report

Task 4: Operation and Maintenance

Task 5: Performance Monitoring

Task 1: RD/RA Work Plan

The Settling Defendants shall submit an RD/RA Work Plan which shall document the overall management strategy for performing the design, construction, operation, maintenance and monitoring of the RD/RA, and which includes a detailed description of the remediation and construction activities. The RD/RA Work Plan shall include a project schedule for each major activity and submission of deliverables generated during the RD/RA for review and approval by the USEPA, in consultation with the Illinois EPA. The plan shall document the responsibility and authority of all organizations and key personnel involved with implementation and shall include a description of qualifications of key personnel directing the RD/RA, including contractor personnel. The RD/RA Work Plan shall also contain a schedule of RD/RA activities.

Task 2: Remedial Design Phases

Settling Defendants shall prepare construction plans and specifications to implement the Remedial Actions at the OU as described in the ROD and this SOW. Plans and specifications shall be submitted in accordance with the schedule set forth in Section V below. Subject to approval by USEPA, Settling Defendants may submit more than one set of design submittals reflecting different components of the Remedial Action. All plans and specifications shall be developed in accordance with U.S. EPA's Superfund Remedial Design and Remedial Action Guidance (OSWER Directive No. 9355.0-4A) and shall demonstrate that the Remedial Action shall meet all objectives of the ROD, the UAO and this SOW, including all Performance Standards. Settling Defendants shall meet regularly with USEPA to discuss design issues.

C. Prefinal and Final Designs

Settling Defendants shall submit the Prefinal Design when the design effort is 95% complete and shall submit the Final Design when the design effort is 100% complete. The Prefinal Design shall fully address, to the satisfaction of USEPA, all comments made by the USEPA during the course of any meetings, conference calls, or discussions during the remedial design phase. The Final Design shall fully address all comments made to the Prefinal Design and shall include reproducible drawings and specifications suitable for bid advertisement. The Prefinal Design shall serve as the Final Design if USEPA has no further comments and issues the notice to proceed.

The Prefinal Design submittal shall include or discuss, at a minimum, the following:

- Preliminary plans, drawings, and sketches, including design calculations;
- Results of treatability studies and additional field sampling;
- Design assumptions and parameters, including design restrictions, process performance criteria, appropriate unit processes for the treatment train, and expected removal or treatment efficiencies for both the process and waste (concentration and volume);
- Proposed cleanup verification methods, including compliance with Applicable or Relevant and Appropriate Requirements (ARARs);
- Outline of required specifications;

- Proposed siting locations of processes/construction activity;
- Expected long-term monitoring and operation requirements;
- Real estate, easement, and permit requirements;
- Preliminary construction schedule, including contracting strategy.
- Draft Performance Standard Verification Plan;
- Draft Construction Quality Assurance Plan;
- Draft QAPP/Draft Health and Safety Plan/Draft Field Sampling Plan/Draft Contingency Plan.

Final Design submittal shall include those elements listed for the Prefinal Design, as well as, the following:

- Final Performance Standard Verification Plan;
- Final Construction Quality Assurance Plan;
- Final QAPP/Final H & S Plan/Final FSP/Final Contingency Plan;
- Draft Operation and Maintenance Plan;
- Capital and Operation and Maintenance Cost Estimate. This cost estimate shall refine the FS cost estimate to reflect the detail presented in the Final Design;
- Final Project Schedule for the construction and implementation of the Remedial Action which identifies timing for initiation and completion of all critical path tasks. The final project schedule submitted as part of the Final Design shall include specific dates for completion of the project and major milestones.

Task 3: Remedial Action Construction

The Settling Defendants shall implement the Remedial Action as detailed in the approved Final Design. The following activities shall be completed in constructing the Remedial Action.

A. Preconstruction inspection and meeting:

The Settling Defendants shall participate with the USEPA and the State in a preconstruction inspection and meeting to:

a. Review methods for documenting and reporting inspection data;

b. Review methods for distributing and storing documents and reports;

c. Review work area security and safety protocol;

d. Discuss any appropriate modifications of the construction quality assurance plan to ensure that site-specific considerations are addressed; and,

e. Conduct a Site walk-around to verify that the design criteria, plans, and specifications are understood and to review material and equipment storage locations.

The preconstruction inspection and meeting shall be documented by a designated person and minutes shall be transmitted to all parties.

B. Prefinal inspection:

Within 15 days after Settling Defendants make preliminary determination that construction is complete, the Settling Defendants shall notify the USEPA and the State for the purposes of conducting a prefinal inspection. The prefinal inspection shall consist of a walk-through inspection of the entire Facility with USEPA. The inspection is to determine whether the project is complete and consistent with the contract documents and the Remedial Action. Any outstanding construction items discovered during the inspection shall be identified and noted. Additionally, treatment equipment shall be operationally tested by the Settling Defendants. The Settling Defendants shall certify that the equipment has performed to meet the purpose and intent of the specifications. Retesting shall be completed where deficiencies are revealed. The prefinal inspection report shall outline the outstanding construction items, actions required to resolve items, completion date for these items, and a proposed date for final inspection.

C. Final inspection:

Within 15 days after completion of any work identified in the prefinal inspection report, the Settling Defendants shall notify the U.S. EPA and the State for the purposes of conducting a final inspection. The final inspection shall consist of a walk-through inspection of the Facility by U.S. EPA and the Settling Defendants. The prefinal inspection report shall be used as a checklist with the final inspection focusing on the outstanding construction items identified in the prefinal inspection. Confirmation shall be made that outstanding items have been resolved.

Reports

1 Final Construction Report

Within 30 days of a successful final inspection, Settling Defendants shall submit a Construction Completion Report. In the report, a registered professional engineer and the Settling Defendants' Project Coordinator shall state that the Remedial Action has been constructed in accordance with the design and specifications. The written report shall include as-built drawings signed and stamped by a professional engineer. The report shall contain the following statement, signed by a responsible corporate official of a Settling Defendant or the Settling Defendants' Project Coordinator:

"To the best of my knowledge, after thorough investigation, I certify that the information contained in or accompanying this submission is true, accurate and complete. I am aware thei are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Task 4: Operation and Maintenance

The Settling Defendants shall prepare an Operation and Maintenance (O&M) Plan to cover both implementation and long term maintenance of the Remedial Actions. An initial Draft O&M Plan shall be submitted as a final Design Document submission. The final O&M Plan shall be submitted to U.S. EPA prior to the pre-final construction inspection, in accordance with the approved construction schedule. The plan shall be composed of the following elements:

1. Description of normal operation and maintenance ;

    a. Description of tasks for operation;
    b. Description of tasks for maintenance;
    c. Description of prescribed treatment or operation conditions; and
    d. Schedule showing frequency of each O&M task.

2. Description of potential operating problems;

    a. Description and analysis of potential operation problems;
    b. Sources of information regarding problems; and
    c. Common and/or anticipated remedies.

3. Description of routine monitoring and laboratory testing;

    a. Description of monitoring tasks,

b. Description of required data collection, laboratory tests and their interpretation;
c. Required quality assurance, and quality control ;
d. Schedule of monitoring frequency and procedures for a petition to USEPA to reduce the frequency of or discontinue monitoring; and
e. Description of verification sampling procedures if Cleanup or Performance Standards are exceeded in routine monitoring.

4. Description of alternate O&M;

   a. Should systems fail, alternate procedures to prevent release or threatened releases of hazardous substances, pollutants or contaminants which may endanger public health and the environment or exceed performance standards; and
   b. Analysis of vulnerability and additional resource requirement should a failure occur.

5. Corrective Action;

   a. Description of corrective action to be implemented in the event that cleanup or performance standards are exceeded; and
   b. Schedule for implementing these corrective actions.

6. Safety plan;

   a. Description of precautions, of necessary equipment, etc., for Site personnel; and
   b. Safety tasks required in event of systems failure.

7. Description of equipment; and

   a. Equipment identification;
   b. Installation of monitoring components;
   c. Maintenance of Site equipment; and
   d. Replacement schedule for equipment and installed components.

8. Records and reporting mechanisms required.

   a. Operating logs;
   b. Laboratory records;
   c. Records for operating costs;
   d. Mechanism for reporting emergencies;
   e. Personnel and maintenance records; and
   f. Reports, as required, pursuant to the approved Final O&M Plan.

Task 5: Performance Monitoring

Performance monitoring shall be conducted to ensure that all Performance Standards are met.

A. Performance Standard Verification Plan

The purpose of the Performance Standard Verification Plan is to provide a mechanism to ensure that both short-term and long-term Performance Standards for the Remedial Action are met. The Draft Performance Standards Verification Plan shall be submitted with the Intermediate Design. Once approved, the Performance Standards Verification Plan shall be implemented on the approved schedule. The Performance Standards Verification Plan shall include:

1. Quality Assurance Project Plan
2. Health and Safety Plan
3. Field Sampling Plan

IV. CONTENT OF SUPPORTING PLANS

The documents listed in this section -- the Quality Assurance Project Plan, the Field Sampling Plan, the Health and Safety Plan, the Contingency Plan and the Construction Quality Assurance Plan -- are documents which must be prepared and submitted as outlined in Section III of this SOW. The following section describes the required contents of each of these supporting plans.

A. Quality Assurance Project Plan

The Settling Defendants shall develop a Site specific Quality Assurance Project Plan (QAPP), covering sample analysis and data handling for samples collected in all phases of future Site work, based upon the Consent Decree and guidance provided by USEPA. The QAPP shall be consistent with the requirements of the EPA Contract Lab Program (CLP) for laboratories proposed outside the CLP. The QAPP shall at a minimum include:

Project Description
- Facility Location History
- Past Data Collection Activity
- Project Scope
- Sample Network Design
- Parameters to be Tested and Frequency
- Project Schedule

Project Organization and Responsibility

Quality Assurance Objective for Measurement Data

* Level of Quality Control Effort
* Accuracy, Precision and Sensitivity of Analysis
* Completeness, Representativeness and Comparability

Sampling Procedures

Sample Custody
* Field Specific Custody Procedures
* Laboratory Chain of Custody Procedures

Calibration Procedures and Frequency
* Field Instruments/Equipment
* Laboratory Instruments

Analytical Procedures
* Non-Contract Laboratory Program Analytical Methods
* Field Screening and Analytical Protocol
* Laboratory Procedures

Internal Quality Control Checks
* Field Measurements
* Laboratory Analysis

Data Reduction, Validation, and Reporting
* Data Reduction
* Data Validation
* Data Reporting

Performance and System Audits
* Internal Audits of Field Activity
* Internal Laboratory Audit
* External Field Audit
* External Laboratory Audit

Preventive Maintenance
* Routine Preventative Maintenance Procedures and Schedules
* Field Instruments/Equipment
* Laboratory Instruments

Specific Routine Procedures to Assess Data Precision,
Accuracy, and Completeness
* Field Measurement Data
* Laboratory Data

Corrective Action
* Sample Collection/Field Measurement
* Laboratory Analysis

Quality Assurance Reports to Management

The Settling Defendants shall participate in a pre-QAPP meeting/conference call with U.S. EPA.

B. Health and Safety Plan

The Settling Defendants shall develop a health and safety plan which is designed to protect on-site personnel and area residents from physical, chemical and all other hazards posed by this remedial action. The safety plan shall develop the performance levels and criteria necessary to address the following areas:

Facility Description
Personnel
Levels of protection
Safe work practices and safe guards
Medical surveillance
Personal and environmental air monitoring
Personal protective equipment
Personal hygiene
Decontamination - personal and equipment
Site work zones
Contaminant control
Contingency and emergency planning
Logs, reports and record keeping

The safety plan shall follow U.S. EPA guidance and all OSHA requirements as outlined in 29 CFR 1910 and 1926.

C. Contingency Plan

Settling Defendants shall submit a Contingency Plan describing procedures to be used in the event of an accident or emergency at the site. The Contingency Plan may be part of the Health and Safety Plan or a separate document. The draft Contingency Plan shall be submitted with the prefinal design and the final Contingency Plan shall be submitted with the final design. The Contingency Plan shall include, at a minimum, the following:

1. Name of the person or entity responsible for responding in the event of an emergency incident.

2. Plan and date(s) for meeting(s) with the local community, including local, State and Federal agencies involved in the cleanup, as well as local emergency squads and hospitals.

3. First aid medical information.

4. Air Monitoring Plan (if applicable).

5. Spill Prevention, Control, and Countermeasures (SPCC) Plan (if applicable), as specified in 40 CFR Part 109 describing measures to prevent and contingency plans for potential spills and discharges from materials handling and transportation.

C. Field Sampling Plan

The Settling Defendants shall develop a field sampling plan (as described in "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA," October 1988). The Field Sampling Plan should supplement the QAPP and address all sample collection activities.

D. Construction Quality Assurance Plan

Settling Defendants shall submit a Construction Quality Assurance Plan (CQAP) which describes the Site specific components of the quality assurance program which shall ensure that the completed project meets or exceeds all design criteria, plans, and specifications. The draft CQAP shall be submitted with the prefinal design and the final CQAP shall be submitted with the final design. The CQAP shall contain, at a minimum, the following elements:

1. Responsibilities and authorities of all organizations and key personnel involved in the design and construction of the Remedial Action.

2. Qualifications of the Quality Assurance Official to demonstrate he possesses the training and experience necessary to fulfill his identified responsibilities.

3. Protocols for sampling and testing used to monitor construction.

4. Identification of proposed quality assurance sampling activities including the sample size, locations, frequency of testing, acceptance and rejection data sheets, problem identification and corrective measures reports, evaluation reports, acceptance reports, and final documentation. A description of the provisions for final storage of all records consistent with the requirements of the Unilateral Administrative Order (UAO) shall be included.

5. Reporting requirements for CQA activities shall be described in detail in the CQA plan. This shall include such items as daily summary reports, inspection data sheets, problem identification and corrective measures

[illegible] documentation. [illegible] final storage of all records shall be presented [illegible] the CQA plan.

V. SUMMARY OF MAJOR DELIVERABLES/SCHEDULE

A summary of the project schedule and reporting requirements contained in this SOW is presented below:

Submission	Due Date
1. RD/RA Work Plan	Within thirty (45) days after the effective date of the UAO
4. Prefinal Design (95%)	Thirty (30) days after USEPA's approval of Final RD/RA Work Plan
5. Final Design (100%)	Thirty (30) days after receipt of USEPA's comments on the Prefinal Design
6. Award RA Contract(s)	Thirty (30) days after receipt of USEPA's Notice of Authorization to Proceed with RA
7. Pre-Construction Inspection and Meeting	(15) days after Award of RA Contract(s)
8. Initiate Construction of RA	15 days after Pre-Construction Inspection and meeting
9. Completion of Construction	Within 8 months of effective date of UAO
10. Prefinal Inspection	No later than 15 days after completion of construction
11. Prefinal Inspection Report	15 days after completion of prefinal inspection
12. Final Inspection	15 days after completion of work identified in prefinal inspection report
13. Final O&M Plan	No later than Prefinal Inspection

14.	Construction Completion Report	30 days after final inspection

SENDER: COMPLETE THIS SECTION

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

CORKERY FUEL COMPAN
c/o MARY ANNE SCHEONB[illegible]ER AGENT
1017 MARY CANDANCE LANE
[illegible] OUIS MO 6312[illegible]

COMPLETE THIS SECTION ON DELIVERY

A. Received by (Please Print Clearly) B. Date of Delivery

C. Signature

X ☐ Agent ☐ Addressee

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☐ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (Extra Fee) ☐ Yes

7099 3400 0000 9591 5357

Domestic Return Receipt Rutati [illegible] 102595 99 M 1789

PLACE STICKER AT TOP OF ENVELOPE
TO THE RIGHT OF RETURN ADDRESS
FOLD AT DOTTED LINE

CERTIFIED MAIL

7099 3400 0000 9591 5357

. . on . ental Protection Agency Region V
Mr Mike Rafati Enforcement Specialist
77 West Jackson Blvd SR 6J
Chicago IL 60604

U.S. Postal Service
CERTIFIED MAIL RECEIPT

7099 3400 0000 9591 5...

Mike

SR 6J

Total Post

CROWN CORK & SEAL CO INC
9300 ASHTON RD
PHILADELPHIA PA 19136

PS Form 3800, July 1999

See Reverse for Instruct

CERTIFIED MAIL

CROWN CORK & SEAL CO INC
9300 ASHTON RD
PHILADELPHIA PA 19136

NOT DELIVERABLE AS ADDRESSED UNABLE TO FORWARD

SENDER: *COMPLETE THIS SECTION*

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

COMPLETE THIS SECTION ON DELIVERY

A. Received by *(Please Print Clearly)* B.

C. Signature

X

D. Is delivery address different from item 1?
If YES, enter delivery address below

nental Protection A
Rafati SR-6J
kson Blvd
IL 60604

NOV 5 2002

TO

8.90 Due

FOR POSTAGE
SENDER:
Remove Label, Affix
Postage, and Remail

RETURNED TO SENDER

8.90 Total

Cargill Incorporated
Tax Dept # 26 box 9300
Minneapolis, MN 55440

7001 0320 0006 0177 1933

PLACE STICKER AT TOP OF ENVELOPE TO THE RIGHT
OF THE RETURN ADDRESS. FOLD AT DOTTED LINE

CERTIFIED MAIL

Envir… mental Protec… n Agency Region V
Mr Mi… R… … nfo… ement … ecialis…
77 W… Jackson … d SR …
Chicago …
60604

SENDER: COMPLETE THIS SECTION

- Complete items 1, 2, and 3 Also complete item 4 if Restricted Delivery is desired
- Print your name and address on the reverse so that we can return the card to you
- Attach this card to the back of the mailpiece or on the front if space permits

1 Article Addressed to

CLAYTON CHEMICAL CO
MR SHELDON KORLIN
CLA… TON … EM… CAL ACQUIS… T … ON … LC
1 QUESTOVER CT
ST PETERS MO 63337 4541

COMPLETE THIS SECTION ON DELIVERY

A Received by (Please Print Clearly) | B Date of Delivery

C Signature
X ☐ Agent ☐ Addressee

D Is delivery address different from item 1? ☐ Yes
If YES enter delivery address below ☐ No

3 Service Type
☐ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C O D

4 Restricted Delivery? (Extra Fee) ☐ Yes

2 Article Number (Copy from service label) 7099 3400 0000 4541 5031

PS Form 3811, July 1999 Domestic Return Receipt 102595 99 M 1789

CLAYTON CHEMICAL CO
MR SHELDON KORLIN
c/o CLAYTON CHE… ICAL ACQUISITION LLC
1 QUESTOVER CT
ST PETERS MO 6333… 4541

PLACE STICKER AT TOP OF ENVELOPE
TO THE RIGHT OF RETURN ADDRESS
FOLD AT DOTTED LINE

CERTIFIED MAIL

U.S. Postal Service
CERTIFIED MAIL RECEIPT
(Domestic Mail Only; No Insurance Coverage Provided)

Article Sent To:
Mike SR 6J

1.15
Certified Fee 2.30
1.50
2.55

CLAYTON CHEMICAL CO
MR SHELDON KORLIN
c/o CLAYTON CHEMICAL ACQUISITION LLC
1 QUESTOVER CT

… 0000 4541 5031

KORL001 633762912 1N 27 10/11/02
RETURN TO SENDER
NO FORWARD ORDER ON FILE
UNABLE TO FORWARD
RETURN TO SENDER

FROM

Environmental Protection Agency Region V
Mr. Mike Rafati, Enforcement Specialist
77 West Jackson Blvd. SR-6J
Chicago, IL 60604

ATTEMPTED NOT KNOWN

U.S. Postal Service
CERTIFIED MAIL RECEIPT
(Domestic Mail Only; No Insurance Coverage Provided)

Article Sent To:

Make address unknown 5R65

Postage	$ 2.75
	2.30
	1.75
	6.80

Postmark Here

CARGILL INC
P O BOX 682
EAST ST. LOUIS IL 62202

PS Form 3800

7099 3400 0000 9591 5265

CARGILL INC
P O BOX 682
[redacted]

(ZIP + 4)

PLACE STICKER AT TOP OF ENVELOPE
TO THE RIGHT OF RETURN ADDRESS.
FOLD AT DOTTED LINE

CERTIFIED MAIL

[redacted]

7099 3400 0000 9591 5265

Environmental Protection Agency Region V
Mr. Mike Rafati Enforcement Specialist
77 West Jackson Blvd. SR-6J
Chicago, IL 60604

U.S. Postal Service
CERTIFIED MAIL RECEIPT
(Domestic ... Insurance Coverage Provided)

Article Sent To: mike SR-6J

Postage	$ 2.75
Certified Fee	2.30
Return Receipt Fee (Endorsement Required)	1.75
Restricted Delivery Fee (Endorsement Required)	
Total Postage	6.80

Postmark Here

MALLINCKRODT
16305 SWINGLEY RIDGE ROAD #200
CHESTERFIELD MO 63017

Street, Apt. No.
City, State, Zip

PS Form 3800

See Reverse for Instructions

7099 3400 0000 9591 6736

CHICAGO IL 0CT 02

PRESORTED FIRST-CLASS

U.S. OFFICIAL MAIL
U.S. POSTAGE
PENALTY FOR PRIVATE USE
$300
03.80
METER 458155

SENDER: COMPLETE THIS SECTION

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

MALLINCKRODT
16305 SWINGLEY RIDGE ROAD #200
CHESTERFIELD MO 63017

COMPLETE THIS SECTION ON DELIVERY

A. Received by (Please Print Clearly) B. Date of Delivery

C. Signature
X
☐ Agent
☐ Addressee

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

RECEIVED
OCT 17 2002
SUPERFUND DIVISION

3. Service Type
☐ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (Extra Fee) ☐ Yes

2. Article Number (Copy from service label) 7099 3400 0000 9591 6736

PS Form 3811, July 1999 SR-6J Domestic Return Receipt Rafati 102595-99-M-1789

PLACE STICKER AT TOP OF ENVELOPE
TO THE RIGHT OF RETURN ADDRESS
FOLD AT DOTTED LINE

CERTIFIED MAIL

[redacted]

7099 3400 0000 9591 6736

MALL305 630172912 1901 27 10/11/02
FORWARD TIME EXP RTN TO SEND
:MALLINCKRODT INC
PO BOX 5840
SAINT LOUIS MO 63134-0840
RETURN TO SENDER

16305 SWINGLEY ROAD #200
CHESTERFIELD MO 63017

Environmental Protection Agency Region V
Mr. Mike Rafati, Enforcement Specialist
77 West Jackson Blvd. SR-6J
Chicago, IL 60604

Abco Trash Service & Equipment Co.
412[illegible] Olive Street
St. Louis MO 631[illegible]0
63108

...TICKER AT TOP OF ENVELOPE
TO THE RIGHT OF RETURN ADDRESS.
FOLD AT DOTTED LINE

CERTIFIED MAIL

[redacted]

7099 3400 0000 9591 6408

Environmental [illegible]
Mr. Mike Rafati, Enforcement Specialist
77 West Jackson Blvd. SR-6J
Chicago, IL 60604

[redacted]

CHIC

[redacted]

U.S. Postal Service
CERTIFIED MAIL RECEIPT
(Domestic Mail Only; No Insurance Coverage Provid

7099 3400 0000 9591 6316

Article Sent To:
Incomplete address insufficient SR-6

Postage	$ 4.75
Certified Fee	1.30
Return Receipt Fee (Endorsement Required)	1.75
Restricted Delivery Fee (Endorsement Required)	
Total Postage	5.80

Name (Please P DAVID HAULING
Street, Apt. No. P.O. BOX 939
EDGEMONT STATION
City, State, ZIP. EAST ST. LOUIS, IL 62208

PS Form 3800, July 1999

~~DAVID HAULING~~
~~P.O. BOX 939~~
~~EDGEMONT STATION~~
~~EAST ST. LOUIS, IL 62208~~

STICKER AT TOP OF ENVEL
RIGHT OF RETURN ADDR
FOLD AT DOTTED LINE
CERTIFIED M

[redacted]

19 3400 0000 9591 6316

Mr Mike Pa[illegible] E[illegible]orcement Specia[illegible] Agency Region
[illegible] Bvd SR[illegible]
Chicago IL 60604

U.S. POSTAGE
PHID
CHICAGO IL
60604
OCT 04 '[illegible]
AMOUNT
$0.00
00036705-[illegible]

UNITED STATES POSTAL SERVICE
[redacted]
9268 63105

CAHOKIA TRUST PROPERTIES
135 NORTH MERAMEC AVE
ST LOUIS MO 63105

[illegible]

PLACE STICKER AT TOP OF ENVELOPE
TO THE RIGHT OF RETURN ADDRESS.
FOLD AT DOTTED LINE

CERTIFIED MAIL

[redacted]

7099 3400 0000 9591 5234

Environmental Protection Agency Region V
Mr. Mike Ratch, Enforcement Specialist
77 W..t Jackson Blvd SR-6J
Chicago, IL 60604

RECEIVED
OCT 1 7 2002
SUPERFUND DIVISION

RETURNED TO SENDER
Forwarding Order Expired

CHICAGO IL LOOP
OCT -1 2002

*** RETURN TO SENDER ***
MOVED NO ORDER
NO SUCH NUMBER
ATTEMPTED UNKNOWN
FORWARDING ORDER EXPIRED

RETURNED TO SENDER
Forwarding Order Expired

CERTIFIED MAIL

[redacted]

7099 3400 0000 9591 5982

(ZIP + 4)

Envircni ental Protection Agency Region V
Mr. Mike .afati, Enforcement Specialist
77 West Jackson Blvd. SR-6J
Chicago IL 60604

U.S. Postal Service
CERTIFIED MAIL RECEIPT
(Domestic Mail Only; No Insurance Coverage Provided)

7099 3400 0000 9591 8440

Article Sent To:
MIKE SR-6J

Postage	$ 4.25
Certified Fee	2.30
Return Receipt Fee (Endorsement Required)	1.50
Restricted Delivery Fee (Endorsement Required)	
Total Postage	5.55

Postmark Here

PEAVEY CO
c/o PRENTICE HALL CORP SYSTEMS
3636 N CENTRAL AVE
PHOENIX AZ 85012

PS Form 3800,

PEAVEY CO
c/o PRENTICE HALL CORP SYSTEMS
3636 N CENTRAL AVE
PHOENIX AZ 85012

PLACE STICKER AT TOP OF ENVELOPE
TO THE RIGHT OF RETURN ADDRESS.
FOLD AT DOTTED LINE

CERTIFIED MAIL

[redacted]

7099 3400 0000 9591 8440

FROM

Environmental Protection Agency Region V
Mr. Mi[illegible] Enforcement Specialist
77 West Jackson Blvd. SR-6J
Chicago, IL 60604

U.S. Postal Service
CERTIFIED MAIL RECEIPT
(Domestic Mail Only; No Insurance Coverage Provided)

7099 3400 0000 95[illegible] 5623

Article Sent To:
Dubre 5e 63

Postage	$ 1.25
Certified Fee	2.30
Return Receipt Fee (Endorsement Required)	1.25
Restricted Delivery Fee (Endorsement Required)	
Total Postage	$ 5.6

Name (Please
JERRY RUSSELL BLISS, INC
Street, Apt. No.
149 STRECKER ROAD
City, State, Zip
BALDWIN MO 63011-1905

PS Form 3800

[redacted]
60604
STL1052952048

LN055
RETURN TO SENDER
☐ MOVED LEFT NO ADDRESS
☐ ATTEMPTED NOT KNOWN
☐ UNCLAIMED ☐ REFUSED
☐ NO SUCH STREET ☐ NUMBER
☐ BOX CLOSED NO ORDER
☐ INSUFFICIENT ADDRESS ☐ VACANT
☐ NO MAIL RECEPTACLE
☐ DO NOT REMAIL IN THIS ENVELOPE
☐ NOT DELIVERABLE AS ADDRESSED
☐ UNABLE TO FORWARD

JERRY RUSSELL BLISS, INC
149 STRECKER ROAD
BALDWIN MO 63011-1905

CERTIFIED MAIL
[redacted]
7099 3400 0000 9591 5623

Environmental Protection Agency Region V
Mr. Mike R..., Enforcement Specialist
77 West Jackson Blvd. SR-6J
Chicago, IL 60604

U.S. OFFICIAL MAIL
U.S. POSTAGE

SENDER: *COMPLETE THIS SECTION*

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

CENTURY FOUNDRY
c/o CENTURY ELECTRIC CO
1806 PINE ST
ST. LOUIS MO 63103

63103

COMPLETE THIS SECTION ON DELIVERY

A. Received by *(Please Print Clearly)* B. Date of Delivery

C. Signature
X ☐ Agent ☐ Addressee

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

RECEIVED
OCT 22 2002
SUPERFUND DIV.

3. Service Type
☐ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? *(Extra Fee)* ☐ Yes

2. Article Number *(Copy from service label)* 7099 3400 0000 9591 7063

PS Form 3811, July 1999 Domestic Return Receipt Rafati SR6J 102595-99-M-1789

[redacted]
ZIP: 63103
2283
St. Louis BMC
Workstation #1

CENTURY FOUNDRY
c/o CENTURY ELECTRIC CO
1806 PINE ST
ST. LOUIS MO 63103

?

UNDELIVERABLE AS ADDRESSED

PLACE STICKER AT TOP OF ENVELOPE TO THE RIGHT OF RETURN ADDRESS. FOLD AT DOTTED LINE

CERTIFIED MAIL

[redacted]

7099 3400 0000 9591 7061

Environmental Protection Agency Region V
Mr Mike Rafati, Enforcement Specialist
77 West Jackson Blvd SR-6J
Chicago, IL 60604

ER: COMPLETE THIS SECTION

- Complete items 1, 2, and 3 Also complete item 4 if Restricted Delivery is desired
- Print your name and address on the reverse so that we can return the card to you
- Attach this card to the back of the mailpiece, or on the front if space permits

1 Article Addressed to

A-1 ~~Oil Corporation~~
Thomas Immel, Agent
1118 S 6th St
Springfield, IL
62703

COMPLETE THIS SECTION ON DELIVERY

A Received by (Please Print Clearly) | B Date of Delivery

C Signature
X
☐ Agent
☐ Addressee

D Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below ☐ No

3 Service Type
☐ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C O D

4 Restricted Delivery? (Extra Fee) ☐ Yes

2 Article Number (Copy from service label) 7099 3400 0000 9591 6644

PS Form 3811 July 1999 Domestic Return Receipt 102595 99 M 1789

A-1 Oil Corporation
Thomas Immel, Registered Agent
1118 South 6th Street
Springfield, IL 62703

CERTIFIED MAIL

7099 3400 0000 9591 6644

U.S. Postal Service
CERTIFIED MAIL RECEIPT
(Domestic Mail Only; No Insurance Coverage Provided)

7099 3400 0000 9591 6644

Article Sent To:
Mike Rafati SR6J

Postage $ 4.35
Certified Fee 1.35
Return Receipt Fee (Endorsement Required) 1.25
Restricted Delivery Fee (Endorsement Required)
Total 5.85

Postmark Here

A-1 Oil Corporation
Thomas Immel, Registered Agent
1118 South 6th Street
Springfield, IL 62703

PS Form 3800, July 1999 See Reverse for Instructions

-ı nmᶜ al Protection Agency Region V
Mike Rafati En'ıucement Specialist
77 West Jackson Blvd SR-6J
Chicago IL 60604

U.S. Postal Service
CERTIFIED MAIL RECEIPT
(Domestic Mail Only; No Insurance Coverage Provided)

7099 3400 0000 9591 6019

Article Sent To:
mike SR 65

Postage	$ 4.75
ert eu Fee	2.30
R t r ee eı e E 10 se u	1.25
Rest cte e Endo se e F	
Total Po	8.30

P t ark Here

Name RIVERPORT FLEETING
MR WILLIAM LAYHE REGISTERED AGENT
Street A 7701 FORSYTHE BLVD SUITE 653
CLAYTON ~~MO~~ 63105

PS Form 3800, July 1999 See Reverse for Instru

RIVERPORT FLEETING
MR WILLIAM LAYHE REGISTERED AGENT
7701 FORSYTHE BLVD SUITE 653
CLAYTON MO 63105

CERTIFIED MAIL

[redacted]

7099 3400 0000 9591 6019

SENDER: COMPLETE THIS SECTION

- Complete items 1 2 and 3 Also complete item 4 if Restricted Delivery is desired
- Print your name and address on the reverse so that we can return the card to you
- Attach this card to the back of the mailpiece or on the front if space permits

1 Article Addressed to

RIVERPORT FLEETING
MR WILLIAM LAYHE REGISTERED AGENT
7701 FORSYTHE BLVD SUITE 653
CLAYTON MO 63105

COMPLETE THIS SECTION ON DELIVERY

A Received by *(Please Print Clearly)* B Date of Delivery

C Signature
X ☐ Agent ☐ Addressee

D Is delivery address different from item 1? ☐ Yes
If YES enter delivery address below ☐ No

3 Service Type
☐ Certified Mail ☒ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4 Restricted Delivery? *(Extra Fee)* ☐ Yes

2 Article Number *(Copy from service label)* 7099 3400 0000 9591 6019

PS Form 3811 July 1999 Domestic Return Receipt 102595 99 M 1789

Environmental Protection Agency Region V
M. Mike Rafati, Enforcement Specialist
77 West Ja... Blvd SP 6J
Chicago, Il 60604

A 60602
2002

U.S. Postal Service
CERTIFIED MAIL RECEIPT
(Domestic Mail Only; No Insurance Coverage Provided)

7099 3400 0000 9591 5326

Article Sent To:

Mike SR65

Postage $	1.15
Certified Fee	2.10
Return Receipt Fee (Endorsement Required)	1.75
Restricted Delivery Fee (Endorsement Required)	
Total Postage	5.5_

Name (Please P... CENTURY ELECTRIC CO
Street Apt No 1806 PINE STREET
City State ZIP+ ST LOUIS MO 63110

CERTIFIED MAIL

7099 3400 0000 9591 5326

CENTURY ELECTRIC CO
1806 PINE STREET
ST LOUIS MO 631..

RETURN TO SENDER
UNDELIVERABLE AS ADDRESSED ... FORWARD

SENDER: COMPLETE THIS SECTION

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

CENTURY ELECTRIC CO
1806 PINE STREET
ST LOUIS MO 631..

COMPLETE THIS S...

A. Received by (Please Print Clearly) | B. Date of D...

C. Signature
X ☐ Agent ☐ Addressee

D. ... different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☐ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt ...
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (Extra Fee)

2. Article Number (Copy from service label) 7099 34000000...

PS Form 3811, July 1999 SR6J Domestic Return Receipt

Environmental Protection Agency Region V
Mr Mike Rafati Enforcement Specialist
77 West Jackson Blvd SR 6J
Chicago IL 60604

NOTRE DAME FLEETING & TOWING SERVICE
MR. RICHARD D BURKE REGISTERED AGENT
200 [redacted] BROADWAY SUITE 1725
MO 63102

CERTIFIED MAIL

[redacted]

7099 3400 0000 9591 6859

SENDER: COMPLETE THIS SECTION

- Complete items 1 2 and 3 Also complete item 4 if Restricted Delivery is desired
- Print your name and address on the reverse so that we can return the card to you
- Attach this card to the back of the mailpiece or on the front if space permits

1 Article Addressed to

NOTRE DAME FLEETING & TOWING SERVICE
MR RICHARD D BURKE REGISTERED AGENT
200 SOUTH BROADWAY SUITE 1725
ST LOUIS MO 63102

COMPLETE THIS SECTION ON DELIVERY

A Received by (Please Print Clearly) | B Date of Delivery

C Signature
X
☐ Agent
☐ Addressee

D Is delivery address different from item 1? ☐ Yes
If YES enter delivery address below ☐ No

3 Service Type
☐ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C O D

4 Restricted Delivery? (Extra Fee) ☐ Yes

2 Article Number (Copy from service label)
7099 3400 0000 9591 6859

PS Form 3811 July 1999 SR & T Domestic Return Receipt Rafati 102595 99 M 1789

DOTSON DISPOSE ALL SERVICE
4727 FLETCHER ST
ST LOUIS MO 63121

SENDER: COMPLETE THIS SECTION

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired
- Print your name and address on the reverse so that we can return the card to you
- Attach this card to the back of the mailpiece, or on the front if space permits

1 Article Addressed to

DOTSON DISPOSE ALL SERVICE
4727 FLETCHER ST
ST LOUIS MO 63121

COMPLETE THIS SECTION ON DELIVERY

A Received by (Please Print Clearly) R BUNRY
B Date of Delivery NOV 0

C Signature
X R Bunry
☐ Agent
☐ Addressee

D Is delivery address different from item 1? ☐ Yes
If YES enter delivery address below ☐ No

3 Service Type
☐ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C O D

4 Restricted Delivery? (Extra Fee) ☐ Yes

2 Article Number (Copy from service label) 7099 3400 0000 9591 547

PS Form 3811, July 1999 SR6J Domestic Return Receipt Rafati 102595 99-M-1789

... Enforcement Specialist
77 West Jackson Blvd SR-6J
Chicago, IL 60604

CERTIFIED MAIL

[redacted]

7099 3400 0000 9591 5470

Environmental Protection Agency Region V
Mr Mike Rafati Enforcement Specialist
77 West Jackson Blvd SR-6J
Chicago IL 60604

7099 3400 0000 9591 5685

U.S. Postal Service
CERTIFIED MAIL RECEIPT
(Domestic Mail Only: No Insurance Coverage Provided)

Article Sent To:
Mike Yacant bldg SR 6J

Postage	$ 4 20
Certified Fee	2 3c
Return Receipt Fee (Endorsement Required)	1 25
Restricted Delivery Fee (Endorsement Required)	
Total Postage & Fees	8. 1c

Postmark Here

EVANS BROTHERS HAULING INC
EUGENE EVANS JR
1201 DUNN RD
ST LOUIS MO 63118

PS Form 3800, July 1999

MAIN OFFICE FINANCE
OCT 0 9 '02
USPS

EVANS BROTHERS HAULING INC
EUGENE EVANS JR
1201 DUNN RD
ST LOUIS MO 631 38

CERTIFIED MAIL

[redacted]

7099 3400 0000 9591 5685

SENDER: *COMPLETE THIS SECTION*

- Complete items 1, 2 and 3 Also complete item 4 if Restricted Delivery is desired
- Print your name and address on the reverse so that we can return the card to you
- Attach this card to the back of the mailpiece, or on the front if space permits

1 Article Addressed to

EVANS BROTHERS HAULING INC
EUGENE EVANS JR
1201 DUNN RD
ST LOUIS MO 631 38

COMPLETE THIS SECTION ON DELIVERY

A Received by *(Please Print Clearly)* R BUNDY
B Date of Delivery OCT 15 2002
C Signature
X R Bundy
☐ Agent
☐ Addressee
D Is delivery address different from item 1? ☐ Yes
If YES enter delivery address below ☐ No

RECEIVED
OCT 16 2002
SUPERFUND

3 Service Type
☐ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C O D

4 Restricted Delivery? *(Extra Fee)* ☐ Yes

2 Article Number *(Copy from service label)* 7099 3400 000 9591 5685

PS Form 3811 July 1999 SR6J Domestic Return Receipt Rafati 102595 99 M 1789

Environmental Protection Agency Region V
Mr. Mike Rafati, Enforcement Specialist
77 West Jackson Blvd. SR-6J
Chicago, IL 60604

U.S. POSTAGE
PAID
CHICAGO, IL
60604
OCT 04, 02
AMOUNT
$0.00
00036705-29

UNITED STATES POSTAL SERVICE
9268 63102

U.S. Postal Service
CERTIFIED MAIL RECEIPT
(Domestic Mail Only; No Insurance Coverage Provided)

7099 3400 0000 9591 5654

Article Sent To:
Mike Expedited forwarding order SR 65

Postage	$ 4.75
Certified Fee	2.30
Return Receipt Fee (Endorsement Required)	1.75
Restricted Delivery Fee (Endorsement Required)	
Total Postage	8.80

CHICAGO IL LOOP STA
Postmark
OCT 4 2002
USPO

Name (Please ... EAGLE MARINE INDUSTRIES INC
MR RICHARD BURKE
Street, Apt. N... 200 NORTH BROADWAY
City, State, Z... ST LOUIS MO 63102-2730

PS Form 3800 ... ions

EAGLE MARINE INDUSTRIES INC
MR RICHARD BURKE
200 NORTH BROADWAY
ST LOUIS MO 63102-2730

CERTIFIED MAIL

[redacted]

7099 3400 0000 9591 5654

SENDER: *COMPLETE THIS SECTION*

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

EAGLE MARINE INDUSTRIES INC
MR RICHARD BURKE
200 NORTH BROADWAY
ST LOUIS MO 63102-2730

COMPLETE THIS SECTION ON DELIVERY

A. Received by *(Please Print Clearly)* R. Burky
B. Date of Delivery OCT 11 2002

C. Signature
X R. Burky ☐ Agent ☐ Addressee

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☐ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? *(Extra Fee)* ☐ Yes

2. Article Number (Copy from service label) 7099 3400 0000 9591 5654

PS Form 3811, July 1999 Domestic Return Receipt 102595-99-M-...

Environmental Protection Agency Region V
Mr Mike Rafat Enforcement Specialist
77 West Jackson Blvd SR-6J
Chicago IL 60604

7099 3400 0000 9591 5142

Article Sent To
Mike Addressee

Postage $ 4.25
Certified Fee 2.30
Return Receipt Fee (Endorsement Required) 1.25
Restricted Delivery Fee (Endorsement Required)
Total Postage 8.80

LOOP STA
Postmark Here

CORKERY FUEL COMPANY
4401 RIDGEWOOD AVE
ST LOUIS MO 63116

PS Form 3800, July 1999

USPS

CORKERY FUEL COMPANY
4401 RIDGEWOOD AVE
ST LOUIS MO 63116

PLACE STICKER AT TOP OF ENVELOPE
TO THE RIGHT OF RETURN ADDRESS.
FOLD AT DOTTED LINE

CERTIFIED MAIL

[redacted]

7099 3400 0000 9591 5142

SENDER: COMPLETE THIS SECTION

- Complete items 1 2 and 3 Also complete item 4 if Restricted Delivery is desired
- Print your name and address on the reverse so that we can return the card to you
- Attach this card to the back of the mailpiece or on the front if space permits

1 Article Addressed to

CORKERY FUEL COMPANY
4401 RIDGEWOOD AVE
ST LOUIS MO 63116

COMPLETE THIS SECTION ON DELIVERY

A Received by (Please Print Clearly) B Date of Delivery

C Signature
X ☐ Agent ☐ Addressee

D Is delivery address different from item 1? ☐ Yes
If YES enter delivery address below ☐ No

3 Service Type
☐ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C O D

4 Restricted Delivery? (Extra Fee) ☐ Yes

2 Article Number (Copy from service label) 7099 3400 00009591 5142

PS Form 3811 July 1999 5R6J Domestic Return Receipt Rafat 102595 99 M 1789

Environmental Protection Agency Region V
Mr Mike Rafati, Enforcement Specialist
77 West Jackson Blvd SR-6J
Chicago, IL 60604

U.S. Postal Service
CERTIFIED MAIL RECEIPT
(Domestic Mail Only; No Insurance Coverage Provided)

7099 3400 0000 9591 5890

Article Sent To:
Over - Forwarding Order expired SR 65

Postage	$ 1 75
Certified Fee	2 30
Return Receipt Fee (Endorsement Required)	1 75
Restricted Delivery Fee (Endorsement Required)	
Total Postage	5 80

Postmark Here

Name (Please Print Clearly) HEUFFMEIER BROTHERS
Street and Apt. No. 11506 BOWLING GREEN DRIVE
City, State ST LOUIS MO 63146

PS Form 3800

CERTIFIED MAIL

7099 3400 0000 9591 5890

HEUFFMEIER BROTHERS
11506 BOWLING GREEN DRIVE
ST LOUIS MO 63146

FORWARDING ORDER EXPIRED
RETURN TO SENDER

SENDER: COMPLETE THIS SECTION

- Complete items 1, 2 and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece or on the front if space permits.

1 Article Addressed to:

HEUFFMEIER BROTHERS
11506 BOWLING GREEN DRIVE
ST LOUIS MO 63146

COMPLETE THIS SECTION ON DELIVERY

A Received by *(Please Print Clearly)* B Date of Delivery

C Signature
X ☐ Agent ☐ Addressee

D Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below ☐ No

3 Service Type
☐ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4 Restricted Delivery? *(Extra Fee)* ☐ Yes

2 Article Number *(Copy from service label)* 7099 3400 0000 9591 5890

PS Form 3811, July 1999 SR-6J Domestic Return Receipt Rafati 102595-99-M-1789

Environmental ... on Agency Region V
Mr Mike Rafati, ... ement Specialist
77 West Jackson ... SR 6J
Chicago IL 60...

SENDER: COMPLETE THIS SECTION

- Complete items 1 2 and 3 Also complete item 4 if Restricted Delivery is desired
- Print your name and address on the reverse so that we can return the card to you
- Attach this card to the back of the mailpiece or on the front if space permits

1 Article Addressed to

EDGEMONT CONSTRUCTION
MR LEONARD KAYE REGISTERED AGENT
P O BOX 12540
ST LOUIS MO 63141

BOX CLOSED
NO FORWARDING
ORDER ON FILE

COMPLETE THIS SECTION ON DELIVERY

A Received by (Please Print Clearly) R BURNS B Date of Delivery OCT 15 2002

C Signature
X R Burns ☐ Agent ☐ Addressee

D Is delivery address different from item 1? ☐ Yes
If YES enter delivery address below ☐ No

3 Service Type
☒ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C O D

4 Restricted Delivery? (Extra Fee) ☐ Yes

2 Article Number (Copy from service label) 7099 3400 0000 9591 6460

PS Form 3811 July 1999 Domestic Return Receipt 102595 99 M 1789

EDGEMONT CONSTRUCTION
MR LEONARD KAYE REGISTERED AGENT
P O BOX 12540
ST LOUIS MO 63141

ORDER ON

U.S. Postal Service
CERTIFIED MAIL RECEIPT
(Domestic Mail Only; No Insurance Coverage Provided)

7099 3400 0000 9591 6460

Article Sent To: Mike Closed box no forwarding order SR 6J Sargent

Postage	6.375
Certified Fee	2.30
Return Receipt Fee (Endorsement Required)	1.25
Restricted Delivery Fee (Endorsement Required)	5.50
Total Postage	

Postmark Here

Name (Please Print Clearly) EDGEMONT CONSTRUCTION
MR LEONARD KAYE REGISTERED AGENT
Street Apt P O BOX 12540
City State ST LOUIS MO 63141

PS Form 3800, July 1999

CERTIFIED MAIL

7099 3400 0000 9591 6460

Environmental Protection Agency Region V
Mr Mike Rafati Enforcement Specialist
77 West Jackson Blvd SR 6J
Chicago IL 60604

SENDER: COMPLETE THIS SECTION

- Complete items 1 2 and 3 Also complete item 4 if Restricted Delivery is desired
- Print your name and address on the reverse so that we can return the card to you
- Attach this card to the back of the mailpiece or on the front if space permits

1 Article Addressed to

T LOUIS GRAIN COMPANY
113 E MAIN BLVD
EAST ST LOUIS 62201

COMPLETE THIS SECTION ON DELIVERY

A Received by (Please Print Clearly) | B Date of Delivery

C Signature
X
☐ Agent
☐ Addressee

D Is delivery address different from item 1? ☐ Yes
If YES enter delivery address below ☐ No

3 Service Type
☐ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt
☐ Insured Mail ☐ C O D

4 Restricted Delivery? (Extra Fee) ☐ Yes

2 Article Number (Copy from service label) 7099 3400 0000 9591 6137

PS Form 3811 July 1999 Domestic Return Receipt 102595 99 M 1789

U.S. Postal Service
CERTIFIED MAIL RECEIPT
(Domestic Mail Only; No Insurance Coverage Provided)

7099 3400 0000 9591 6137

Article Sent To:
SR 65 mfu

Postage $ 1.13
Certified Fee 2.50
Return Receipt Fee Endorsement Required 1.25
Restricted Delivery Fee Endorsement Required
Total Postage & Fees 8.8

Name (Please Print) ST LOUIS GRAIN COMPANY
Street Apt No 113 E MAIN BLVD
City State ZIP+4 EAST ST LOUIS 62201

PS Form 3800 July

CERTIFIED MAIL

[redacted]

7099 3400 0000 9591 6132

ST LOUIS GRAIN COMPANY
113 E MAIN BLVD
[redacted]